Minerals Yearbook

1974

Volume I

METALS, MINERALS, AND FUELS

Prepared by staff of the

BUREAU OF MINES

UNITED STATES DEPARTMENT OF THE INTERIOR ● Thomas S. Kleppe, Secretary

BUREAU OF MINES ● Thomas V. Falkie, Director

As the Nation's principal conservation agency, the Department of the Interior has basic responsibilities to protect and conserve our land and water, energy and minerals, fish and wildlife, and park and recreation areas, and for the wise use of all those resources. The Department also has a major responsibility for American Indian reservation communities and for the people who live in Island Territories under U.S. administration.

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Foreword

The Federal Government, through the medium of the Minerals Yearbook or its predecessor volumes, has for 92 years reported annually on mineral industry activities. This edition of the Minerals Yearbook presents the record on worldwide mineral industry performance during 1974. In addition to statistics, the volumes provide background information to help in interpreting the year's developments. The content of the individual volumes is as follows:

Volume I, Metals, Minerals, and Fuels, contains chapters on virtually all metallic, nonmetallic, and mineral fuel commodities important to the domestic economy. In addition, it includes a general review chapter on the mineral industries, a statistical summary, and a chapter on mining and quarrying trends.

Volume II, Area Reports: Domestic, contains chapters on the mineral industry of each of the 50 States, the U.S. island possessions in the Pacific Ocean and the Caribbean Sea, the Commonwealth of Puerto Rico, and the Canal Zone. This volume also has a statistical summary, identical to that in Volume I.

Volume III, Area Reports: International, contains the latest available mineral data on more than 130 foreign countries and discusses the importance of minerals to the economies of these nations. A separate chapter reviews minerals in general and their relationships to the world economy.

The Bureau of Mines continually strives to improve the value of the Yearbook for its users. Therefore, the constructive comments and suggestions of readers will be welcomed.

THOMAS V. FALKIE, *Director*.

Acknowledgments

Volume I, Metals, Minerals, and Fuels of the Minerals Yearbook summarizes the significant data pertaining to mineral commodities obtained as a result of the mineral information gathering activities of the Associate Directorate—Mineral and Materials Supply Demand Analysis.

The collection, compilation, and analysis of data on the domestic minerals and mineral fuel industries were performed by the staffs of the Divisions of Ferrous Metals, Nonferrous Metals, Nonmetallic Minerals, Assistant Directorate Metals, Minerals and Materials; the Divisions of Coal, Petroleum and Natural Gas, and Fuels Data, Assistant Directorate, Fuels; and the Division of Economic Analysis, Assistant Directorate, Interindustry and Economic Analysis. Statistical data were compiled from information supplied by mineral producers, processors, and users in response to production and consumption canvasses, and their voluntary response is gratefully acknowledged. The information obtained from individual firms by means of confidential surveys has been grouped to provide statistical aggregates. Data on individual firms are presented only if available from published or other nonconfidential sources or when permission of the companies has been granted. Other material appearing in this volume was obtained from the trade and technical press, industry contacts, and numerous other sources.

Statistics on U.S. imports and exports, world production, and foreign country trade were compiled in the Office of Technical Data Service. The foreign trade data for the United States were obtained from reports of the Bureau of the Census, U.S. Department of Commerce. World production and trade data come from numerous sources, including reports from the Foreign Service, U.S. Department of State.

The Office of Technical Data Services also provided general guidance on the preparation and coordination of the chapters in this volume and reviewed the manuscripts to insure statistical consistency among the tables, figures, and text, between this volume and other volumes, and between this edition and those of former years.

Acknowledgment is also particularly made of the splendid cooperation of the business press, trade associations, scientific journals, international organizations, and other Federal agencies that supplied information.

The Bureau of Mines has been assisted in collecting mine production data and the supporting information appearing in the Minerals Yearbook by numerous cooperating State agencies. These organizations are listed in the acknowledgment to Volume II.

ALBERT E. SCHRECK, *Editor-in-Chief.*

Contents

Page

Foreword, by Thomas V. Falkie, Director iii
Acknowledgments, by Albert E. Schreck v
Review of mineral industries, by Daniel E. Sullivan and Nicholas G. Theofilos 1
Mining and quarrying trends in the metal and nonmetal industries, by John L. Morning 67
Statistical summary, by Staff, Office of Technical Data Services 89
Abrasive materials, by Robert G. Clarke 129
Aluminum, by John W. Stamper and Christine M. Monroe 143
Antimony, by Charlie Wyche 169
Asbestos, by Robert A. Clifton 179
Barite, by Frank B. Fulkerson 191
Bauxite, by Horace F. Kurtz 199
Beryllium, by Benjamin Petkof 217
Bismuth, by Charlie Wyche 223
Boron, by K. P. Wang 229
Bromine, by Charles L. Klingman 235
Cadmium, by Ronald J. DeFillippo 239
Calcium and calcium compounds, by Avery H. Reed 247
Carbon black, by John L. Albright 251
Cement, by Brinton C. Brown 263
Chromium, by John L. Morning 301
Clays, by Sarkis G. Ampian 313
Coal—Bituminous and lignite, by L. Westerstrom and R. E. Harris 349
Coal—Pennsylvania anthracite, by Dorothy R. Federoff 407
Cobalt, by Scott F. Sibley 433
Coke and coal chemicals, by Franklin D. Cooper 441
Columbium and tantalum, by Henry E. Stipp 479
Copper, by Harold J. Schroeder and George J. Coakley 491
Diatomite, by Stanley K. Haines 539
Feldspar, nepheline syenite, and aplite, by J. Robert Wells 543
Ferroalloys, by Norman A. Matthews 553
Fluorspar and cryolite, by H. B. Wood 565
Gallium, by E. Chin 589
Gem stones, by Robert G. Clarke 593
Gold, by J. M. West 603
Graphite, by W. Timothy Adams 627
Gypsum, by Avery H. Reed 635
Helium, by Ronald F. Balazik 643
Iron ore, by F. L. Klinger 651
Iron and steel, by Horace T. Reno 677
Iron and steel scrap, by D. H. Desy 699
Iron oxide pigments, by Thomas S. Jones 713
Kyanite and related minerals, by Michael J. Potter 721
Lead, by J. Patrick Ryan and John M. Hague 727
Lime, by Avery H. Reed 753
Magnesium, by E. Chin 763
Magnesium compounds, by E. Chin 773
Manganese, by Gilbert L. DeHuff 783
Mercury, by Anthony Cammarota, Jr. 799
Mica, by Stanley K. Haines 809

Page

Molybdenum, by Andrew Kuklis ---------------------------------- 819
Natural gas, by Gordon W. Koelling and Leonard L. Fanelli ------ 833
Natural gas liquids, by Ronald Prehoda and Leonard L. Fanelli ---- 873
Nickel, by John D. Corrick ---------------------------------- 899
Nitrogen, by William F. Keyes ---------------------------------- 915
Peat, by Donald P. Mickelsen ---------------------------------- 925
Perlite, by Arthur C. Meisinger ---------------------------------- 935
Petroleum and petroleum products, by William B. Harper, Bernadette Michalski, and Betty M. Moore ---------------------------------- 939
Phosphate rock, by W. F. Stowasser ---------------------------------- 1063
Platinum-group metals, by W. C. Butterman -------------------- 1083
Potash, by William F. Keyes ---------------------------------- 1097
Pumice and volcanic cinder, by Arthur C. Meisinger ------------ 1111
Rare-earth minerals and metals, by James H. Jolly -------------- 1117
Rhenium, by Larry J. Alverson ---------------------------------- 1125
Salt, by Charles L. Klingman ---------------------------------- 1131
Sand and gravel, by Walter Pajalich ---------------------------- 1143
Silicon, by E. Shekarchi ---------------------------------- 1173
Silver, by Thomas G. Clarke ---------------------------------- 1181
Slag—iron and steel, by Harold J. Drake ---------------------- 1201
Sodium and sodium compounds, by Charles L. Klingman --------- 1207
Stone, by Harold J. Drake ---------------------------------- 1215
Sulfur and pyrites, by Roland W. Merwin and William F. Keyes --- 1235
Talc, soapstone, and pyrophyllite, by J. Robert Wells ------------ 1261
Thorium, by Roman V. Sondermayer ---------------------------- 1269
Tin, by Keith L. Harris ---------------------------------- 1277
Titanium, by F. W. Wessel ---------------------------------- 1295
Tungsten, by Richard F. Stevens, Jr. ---------------------------- 1307
Uranium, by Walter C. Woodmansee ---------------------------- 1327
Vanadium, by Grace N. Broderick ---------------------------- 1351
Vermiculite, by Frank B. Fulkerson ---------------------------- 1359
Zinc, by V. Anthony Cammarota, Jr. and Herbert R. Babitzke ---- 1363
Zirconium and hafnium, by Sarkis G. Ampian ------------------ 1397
Minor metals (arsenic, cesium and rubidium, germanium, indium, radium, scandium, selenium, tellurium, thallium), by Staff, Division of Nonferrous Metals ---------------------------------- 1417
Minor nonmetals (greensand, iodine, lithium, meerschaum, quartz crystal, staurolite, strontium, wollastonite), by Staff, Division of Nonmetallic Minerals ---------------------------------- 1434

Review of the Mineral Industries

By Daniel E. Sullivan [1] and Nicholas G. Theofilos [1]

Recession was evident throughout 1974 but accelerated toward the end of the year. The real gross national product (GNP) declined sharply during the first quarter and continued to decline in the next two quarters. During the final quarter the rate of decline was double that of the first quarter. There were also substantial declines in industrial employment and corresponding increases in unemployment, as strong inflation continued and consumer confidence declined. The energy crisis, compounded by the Arab oil embargo, was a major contributing factor to these problems, and the Federal Government took steps to make the United States less dependent on foreign energy sources. Monetary policy was designed to reduce the rate of growth of the money supply, and fiscal policy was characterized by a smaller deficit than anticipated, as inflation caused Federal revenues to increase faster than Federal expenditures.

Real output declined during 1974. The GNP at current prices increased 8%, but because prices rose 10% during the year, real GNP, measured in 1958 dollars, decreased 2%. Real gross private domestic investment in residential structures declined more than 27%, and real personal consumption expenditures for durable goods declined 9%. Real State and local government purchases increased almost 3%, and real personal consumption expenditures for services increased more than 1%. The Federal Reserve Board (FRB) index of industrial production declined almost 1%.

The unemployment rate increased to 5.6% in 1974 from 4.9% in 1973. The number of people employed increased during the year but because the total labor force increased at a greater rate, unemployment rose. The unemployment rate stayed near 5.1% during the first half of the year, during the third quarter it went to 5.5%, and during the fourth quarter it went to 6.6%.

The consumer price index (CPI) increased 11.0% from 1973 to 1974, the greatest rise since the post-World War II period. Although the rate of increase from quarter to quarter was consistent, there were significant shifts in the composition of the rises. During the last 3 quarters of 1974, increases in food and fuel prices no longer dominated the changes in the CPI as they had in the first quarter. After the termination of price controls in April, changes in the CPI were attributed to increases over a broader range of goods. Prices of goods and services in consumer markets as measured by the CPI, and the GNP deflator advanced at fairly steady rates during 1974, but in late spring rates of increase slowed and there were some price reductions in crude and intermediate industrial product markets. Metal prices continued to rise, reflecting large wage gains and higher fuel prices. The wholesale price index for industrial commodities increased from 125.9 points in 1973 to 153.8 in 1974.

As a result of rapid inflation in 1974, the Federal Reserve decided on a gradual reduction in the rate of growth of the money supply. This was considerably below that of 1973 and substantially below the too rapid rate of 1972. The Federal Reserve used its open market operations in order to moderate the rate of monetary expansion. The discount rate reached a record 8% in April but declined to 7¾% by yearend. Consequently, in July the commercial prime rate reached 12% at most major banks, and then fell substantially during the fourth quarter. For the whole year, the money supply rose 4.5%, down from 6.1% in 1973.

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[1] Economist, Division of Economic Analysis.

Fiscal policy was tighter than anticipated in 1974. This was partially because inflation was greater than was expected. Federal expenditures continued to shift away from purchases of goods and services, especially defense expenditures, and toward transfer payments. An $11.7 billion deficit was projected for 1974, but the actual figure was $7.6 billion compared with $5.6 billion in 1973.

Federal activities in areas that affected minerals or the mineral economy included both continuing and special actions. The Federal Government continued to take actions to improve the economy and fight inflation. The Economic Stabilization Act Amendments of 1971, which were the basis for price controls, expired. Inflation was combated without the use of price controls. The Government took a number of steps to improve the energy situation. The subjects of mineral related bills enacted into law included energy, the environment, water, public lands, public safety, gold, and tariffs.

The 1974 research program of the Bureau of Mines was designed to promote the effective utilization of our natural mineral and fuel resources, insuring adequate mineral supplies without objectionable environmental, social, and occupational effects. Late in 1974 the Energy Research and Development Administration (ERDA) was established by Congress, and some of the research functions of the Bureau of Mines were transferred to this organization.

Energy use in the United States during 1974 fell 2.2%, the first decline in more than 2 decades. This was mostly attributed to the Arab oil embargo, higher prices for crude oil, the slowdown of the economy, and efforts by consumers to conserve energy. Consumption declined for all energy sources except utility hydropower and nuclear power. The transportation sector showed the biggest drop of all major consuming sectors. Petroleum and natural gas liquids supplied almost 46% of the energy used, compared with 47% in 1973. The production of bituminous coal, hampered by labor disputes late in the year, increased only 1.4% over that of 1973.

The year 1974 was one of shortages, uncertainties, and increased regulation of the mining industry, but at the same time the mining industry expanded and improved the technologies of mining and exploration. The exploration and development of new ore bodies continued in 1974, despite the ever-increasing risks involved. The nonferrous metals industry had the largest expenditure on pollution control equipment (as a proportion of total capital expenditures) of any industry in the United States.

Most of the world suffered serious economic strains during 1974. Rates of inflation accelerated, and the expansion of real economic activity slowed. These problems were exacerbated by the quadrupling of the price of oil. The oil price increase also caused balance of trade problems for the oil-consuming countries.

SOURCES AND USES

ALL MINERALS

Production.—Domestic raw mineral production was valued at $55.2 billion in 1974, a 50% increase from 1973. In constant 1967 dollars the figure declined more than 2% to $26.3 billion. The value of domestic production of nonmetals increased over 17% in current dollars, but in constant 1967 dollars it declined less than 0.1%. For metals the current value increased over 27% but the constant dollar value declined almost 5%. The current value of mineral fuels output increased almost 64%, however, the constant 1967 dollar value declined almost 3%. Exports of primary minerals and mineral fuels increased over 109% to $3.5 billion, and imports increased almost threefold to $19.4 billion.

The Bureau of Mines indexes of physical volume of mineral production (1967=100) generally declined during 1974 in concert with the general economic recession. The overall index declined almost 3% to 110.9 index points. The index for the average of all metals declined almost 5% to 130.4 index points, the index for the average of all nonmetallic minerals increased almost 1% to 119.7 index points, and the index for the average of all fuels declined almost 4% to 105.4 index points. Within the metals group, the ferrous metals index declined almost 7%, and the index for all nonferrous metals declined almost 4%. The index for base metals declined more than 4%, the index for monetary metals declined 8%, and the index for other nonferrous metals increased more than 6%. In the nonmetals sector the index for construction materials declined almost 2%, the index for chemicals increased more than 8%, and the index for other nonmetallic minerals increased almost 5%. In spite of the decline in the fuel index, the index of production for coal increased almost 2%. The index for crude oil and natural gas declined almost 5%.

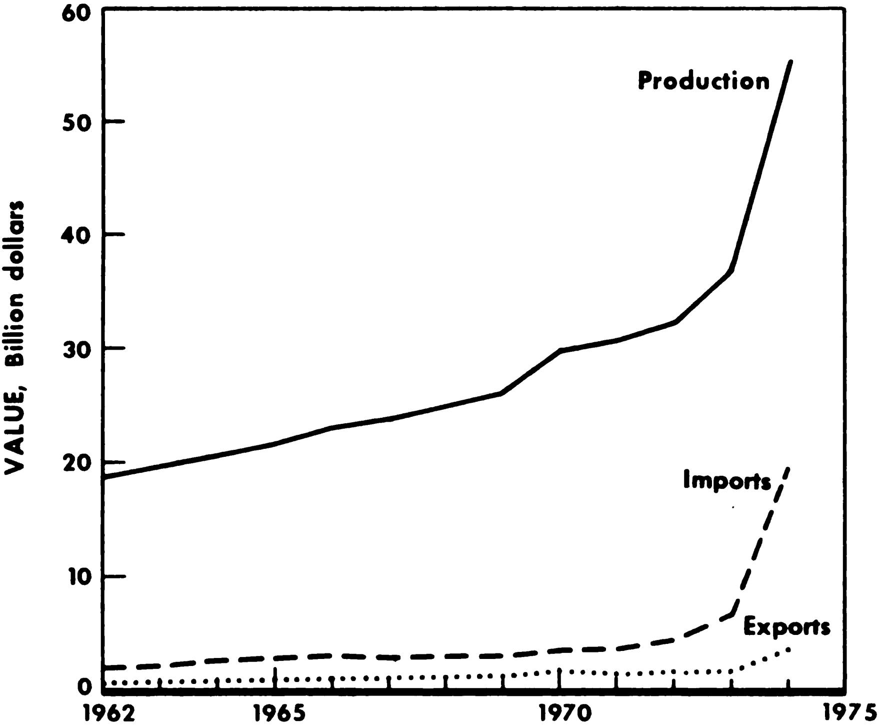

Figure 1.—Value of raw mineral production, exports, and imports.

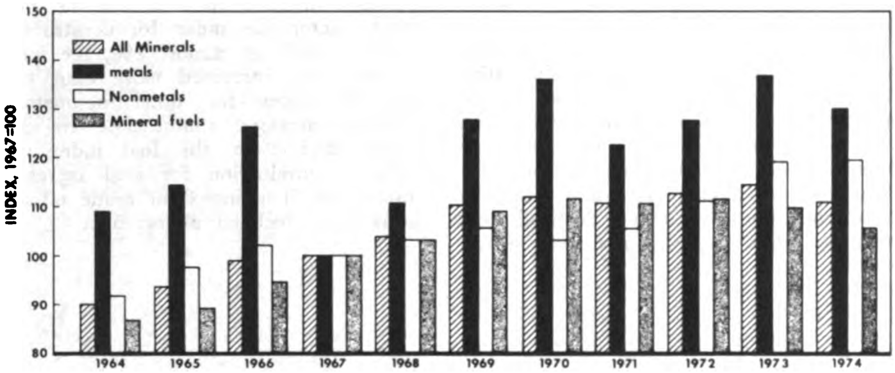

Figure 2.—Indexes of physical volume of mineral production in the United States, by group.

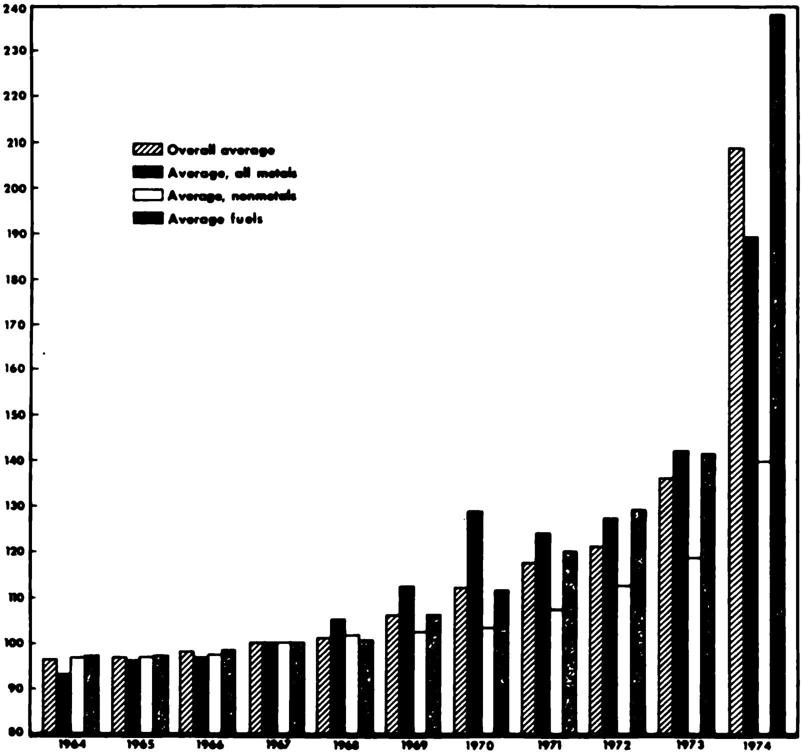

Figure 3.—Indexes of implicit unit value.

The FRB index of industrial production (1967=100) was 124.7 points for all industries in 1974. This was a decline of almost 1% from the 1973 figure. The average index for all mining showed a slight decrease to 109.4 index points. The metal, stone, and earth mineral production indexes also declined slightly. The crude oil and natural gas indexes declined about 4% each. The coal mining index increased slightly but was the only mining index to do so. The metal, clay, glass, and stone manufactured product indexes all declined during 1974. The primary metal index declined 2.3%, the iron and steel index declined 1.5%, the nonferrous metals and products index declined 2.9%, and the clay, glass, and stone products index declined 3.3%.

The FRB average index for all mining by month was 109.9 index points in January. It increased to 112.2 index points in March, then gradually declined to 110.2 index points in July, and dropped to 107.3 in August. It returned to 110.5 by October, but fell to near 105 for the remainder of the year. The monthly index for coal, oil, and gas generally followed this same trend. The coal monthly index, which was 108.7 in January, went up to 114.7 in March, but dropped to 110.3 the next month; it then increased to 118.3 in June, and dropped to 99.4 in August. For the next 2 months it was near 111; then it dropped to 67.6 in November, due to the coal strike. It returned to just about 80 for December. The oil and gas extraction monthly indexes generally followed the trend of the total mining index, except for the crude oil index, which tended to decline throughout the year. The metal, stone, and earth minerals and the metal mining indexes declined in the first half of the year, were lowest in August, returned to a high point in October, then went down a little for the remainder of the year. The stone and earth minerals index remained near 111 for the first 5 months, declined to 106.4 for June, increased to near 110 for August, was 105.0 in September, went up to near 110 for November, and declined to 106.4 for December.

The net supply of principal nonfuel minerals changed in a mixed pattern during 1974. The net supply of most ferrous metals declined during the year. Iron ore, pig iron, and steel ingot declined less than 1%, almost 6%, and almost 4%, respectively. Cobalt declined almost 9%, manganese declined over 59%, and molybdenum declined more than 36%. Tungsten declined less than 1%. Nickel and chromite both increased, by 10% and over 15%, respectively. The net supply of nonferrous metals also changed in a mixed pattern with more commodities showing increases than decreases. Aluminum, copper, and mercury all showed increases of from 6% to 9%. Lead showed an increase of more than 1%. Rutile increased almost 13%, and platinum-group metals increased more than 18%. Antimony and zinc both showed no change. Ilmenite and slag declined more than 5%; cadmium, almost 15%; tin, more than 19%; and uranium, more than 26%. There were more positive changes in the net supplies of nonmetals than negative ones. The net supplies of talc and allied minerals, crude barite, and bromine all increased between 1% and 4%. Those of finished fluorspar, sulfur, and common salt all increased from 5% to just over 6%. Potash increased over 9%, and phosphate rock increased almost 12%. The net supply of sand and gravel and that of crushed stone both declined between 1% and 2%. The net supplies of asbestos, clays, and gypsum all decreased from 6% to 8%. The net supply of mica decreased almost 15%.

Stocks and Government Stockpile.—Stocks of crude nonfuel minerals at primary producers at yearend as shown by Bureau of Mines indexes (1967=100) declined during 1974 for all selected commodities. The total index for crude minerals declined almost 13%, the crude metals index declined almost 18%, and the crude nonmetals index declined just over 3%. In the metal category, the index for iron ore declined 13%, the index for other ferrous ores declined over 37%, and the index for nonferrous ores declined less than 2%. Stocks of mineral manufacturers, consumers, and dealers at yearend as shown by Bureau indexes increased or remained unchanged during 1974 for all selected commodities. The total index for manufacturers' stocks increased almost 18%, the manufactured metal index likewise increased 18%, and the manufactured nonmetals index increased almost 10%. In the metals category the index for iron stocks remained unchanged, the other ferrous index increased 3%, the base nonferrous index increased 27%, and the other nonferrous index increased over 40%.

Producer stocks of bituminous coal and lignite declined over 7% in 1974. Those of coke declined 21%. Near the end of 1974 there was a coal miners strike which made necessary the drawing down of coal and coke stocks which is reflected in these figures. The stock figure for natural gasoline, plant condensates, and isopentane also declined. Yearend producer stocks of all other mineral energy resources and related products were higher than in 1973. The largest increase was a 42% change in petroleum asphalt; the smallest increase was 1% in the other products category. Stocks of carbon black increased almost 28%. Stocks of crude petroleum and petroleum products increased almost 7%. Within this group, stocks of crude petroleum increased over 9%, those of gasoline increased over 4%, and stocks of distillate fuel oil increased almost 2%. Stocks of natural gas increased less than 2%.

The seasonally adjusted book value of product inventories increased substantially for all the selected mineral processing industries during 1974. Petroleum and coal products increased the most, almost 50%, to $3,925 million, as of December 1974. Stone, clay, and glass products increased over 32% to $3,721 million. Inventories of total primary metals increased almost 27% to $11,861 million. Within this group, product inventories of blast furnaces and steel mills increased 23% to $5,747 million, and those of other primary metals increased over 30% to $6,114 million. The total seasonally adjusted book value of inventories for selected mineral processing industries increased almost 32% to $19,507 million during 1973.

U.S. Government inventories of basic stockpile materials were a significant part of the Nation's minerals program during 1974. Commodities of significant market value in the inventories included chromium, lead, manganese, platinum-group metals, silver, tin, tungsten, and zinc.

Exports.—The total value of selected minerals and mineral products exported during 1974 increased more than two-thirds. Exports in all sectors increased substantially: Crude nonmetallic minerals increased 71%; crude and scrap metals increased 36%; chemicals increased 26%; manufactured nonmetallic minerals increased 51%; and manufactured metals increased 72%. These increases are in current value and thus reflect increases both in quantities shipped and in prices. Since prices increased substantially during the year, especially in the fuels area, much of the general increase was the result of price increases.

In general, the geographical distribution of exports of selected mineral commodities for 1974 was similar to that of 1973, although there were major changes in specific commodities. Examples of some of the changes follow: There was a shift in sulfur and unroasted pyrites with more going to Europe and South America in 1974 instead of to North America and Asia; uranium and thorium ores and concentrates were not exported in 1974; coke, coal and briquets, including peat, mostly went to noncentrally controlled Asia in 1974, whereas in 1973 these commodities went mostly to North America; crude and partly refined petroleum all went to North America in 1974, whereas in 1973 it all went to Europe and Asia; silver, platinum, and platinum-group metals exports shifted from Asia to North America; and the share of exports of uranium and thorium and their alloys to North America increased.

Imports.—The total value of selected minerals and mineral products imported during 1974 increased by a factor of more than two and three-eighths. Imports in all sectors increased: Crude nonmetallic minerals increased 24%, crude and scrap metals increased nearly 55%, mineral energy resources increased 213%, chemicals increased 28%, manufactured nonmetallic minerals increased 6%, and manufactured metals increased 72%. Like exports, these are value figures, and as such reflect both quantity and price changes. A significant part of these increases can be attributed to changes in prices.

As was the case for exports, the geographical distribution of imports of selected mineral commodities for 1974 generally followed the previous pattern. Examples of some exceptions include lead ore and concentrate, more of which came from North America instead of South America and Oceania; tungsten ore and concentrate, less of which came from North America; and copper waste and scrap, less from North America and more from Europe and Asia. Also, nickel waste and scrap from North America increased its share; aluminum waste and scrap imports from North America decreased its share; imports of tin waste and scrap from North America increased its share; and the share of platinum-group metals, ores, concentrates, and wastes imports from North America and Asia increased and that from Africa decreased. Shares of coal, coke, and briquets imports from North America decreased and those from Europe increased; and the shares of mineral tar and crude chemicals from coal, petroleum, and natural gas from North America increased while that from Europe declined.

Consumption.—The recession of 1974 was reflected in the consumption of major mineral products. During 1973 this consumption increased substantially for most of the major mineral products, but during 1974 consumption declined for 24 of these 40 selected mineral products. Consumption of half of the selected ferrous metals declined. Iron ore consumption declined 6%; raw steel, more than 3%; metallurgical-grade chromite, 2%; and manganese ore, more than 12%. Refractory-grade chrome consumption increased almost 13%; chemical grade increased almost 22%; molybdenum, over 11%; and tungsten, almost 6%. Consumption of 6 of the 10 selected nonferrous metals declined. Consumption of primary antimony, and all zinc classes each declined more than 10%; the industrial consumption of silver and refined copper declined almost 10%; the apparent consumption of aluminum declined over 3%; and estimated private purchases of uranium declined almost 2%. Primary and secondary lead consumption increased almost 4%, primary mercury consumption increased almost 10%, platinum-group metals increased more than 8%, and ilmenite and titanium slag increased less than 1%. Consumption of 6 of the 10 selected nonmetallic minerals also declined. Consumption of asbestos declined more than 4%; cement, almost 8%; clays, almost 6%; sand and gravel, less than 1%; crushed stone, less than 2%; and sulfur, just over 2%. The nonmetallics that increased were lime, over 2%; phosphate rock, 7%; potash, over 9%; and salt, over 6%. Consumption of all the selected fossil fuels declined, as did utility electricity from conventional fuel-burning plants and the industrial generation of electricity (utility electricity from hydropower and nuclear power increased enough to cause the net generation of electricity to increase). Total energy resource inputs in terms of British thermal units (Btu) declined more than 2% to 73,141 trillion Btu. Consumption of bituminous coal declined almost 1% (coal carbonized for coke declined more than 4%); anthracite declined one-sixth. Consumption of petroleum and natural gas liquids declined almost 4%, and dry natural gas consumption declined more than 3%. Net electricity generation was slightly more than last year, as was electricity from utilities. Utility electricity from hydropower and nuclear power increased more than 9% and 35%, respectively. Utility electricity from conventional fuel-burning plants decreased more than 3%, as did industrial generation of electricity.

ENERGY

As a result of the Arab oil embargo, there was an overall national effort to curtail the use of fuels. As part of this effort the Federal Government encouraged electric utilities to switch to coal where economically feasible in an attempt to conserve oil. Reflecting this effort, energy use in the United States fell 2.2% after steady annual increases for more than 2 decades. There was also a 2.8% decrease in per capita energy use. Consumption declined for all energy sources except hydropower and nuclear power. The ratio of energy use to GNP declined slightly from that of 1973. This trend, which started in 1971, indicated that the U.S. economy was using energy in a more efficient way to create GNP, but it was not necessarily related to efficiency of energy in a physical, thermodynamic sense.

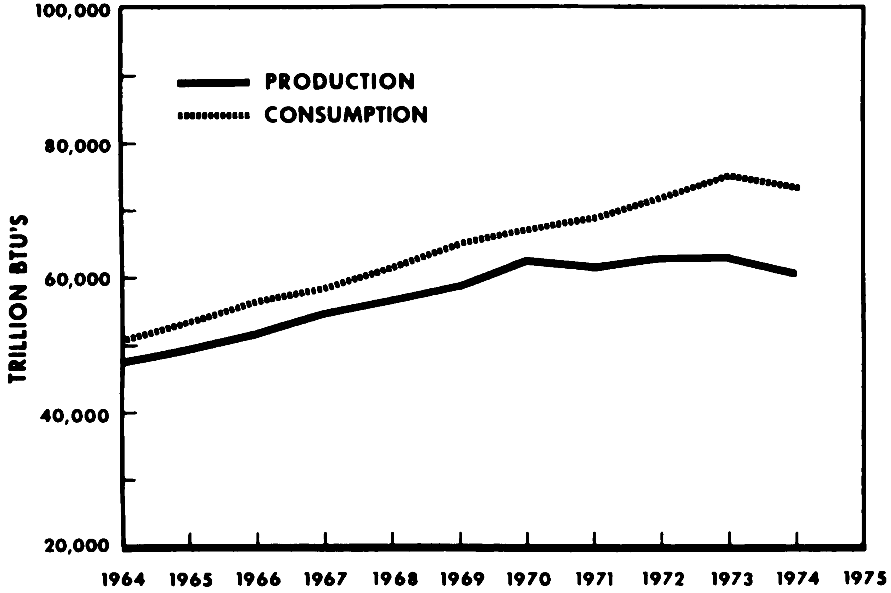

Figure 4.—Production and calculated gross consumption of mineral energy resources and electricity from hydropower and nuclear power.

Production.—Total production of mineral energy resources and electricity from hydropower and nuclear power declined almost 2% during 1974 to 61,197 trillion Btu. Anthracite, wet natural gas, and crude petroleum production all declined in terms of Btu's—over 3%, over 4%, and almost 5%, respectively. Production of bituminous coal, and electricity from hydropower and nuclear power all increased—less than 2%, over 10%, and more than 35%, respectively.

Consumption.—U.S. gross consumption of energy during 1974 decreased a little over 2%, to 73,141 trillion Btu. Consumption of all energy resources declined except for electricity from hydropower and nuclear power which increased 9% and 35%, respectively. Petroleum, excluding natural gas, accounted for about 42% of the energy consumed. Natural gas (dry) contributed slightly over 30%, and bituminous coal and lignite contributed almost 18%. The remaining energy sources individually contributed less than 5% toward the consumption of energy.

In 1974, the household and commercial sector received 43% of its total net energy input from natural gas, the petroleum input declined to 34%, 21% came from electric utilities, and the remainder came from coal. The distribution of the total net energy inputs for industrial users was natural gas 44%, petroleum 25%, coal 18%, electric utilities 11%, and all others less than 2%. Petroleum again accounted for 96% of the total net energy inputs consumed by the transportation sector. Energy inputs to electric utilities were from bituminous coal and lignite, 43%; natural gas, 18%; petroleum, 17%; hydropower, 16%; and nuclear power, 6%.

Coal.—The domestic supply of anthracite during 1974 declined 4% to 5.4 million tons. Production of anthracite declined and exports increased. Almost half of the demand was by the household and commercial sector, and the remainder was divided between industrial uses and the generation of electric power by utilities. The domestic supply of bituminous coal and lignite declined almost 1% to 551 million tons. This decline in supply occurred despite an increase in production because exports increased and withdrawals from stocks during 1974 were half of what they were in 1973. Imports of bituminous coal were more than 16 times greater in 1974 than in 1973. Electric utilities continued to be the predominant user of bituminous coal.

Natural Gas.—The domestic supply of natural gas decreased over 3% during 1974 to 21,512 billion cubic feet. Production, imports, exports, and stock additions all were less in 1974 than in 1973. Production declined almost 5%, exports declined less than 1%, imports decreased over 7%, and net stock additions were more than 81% less than in 1973. The demand for natural gas declined in all sectors except for use as a raw material for chemicals other than carbon black. The total demand declined by more than 3%.

Petroleum.—The domestic crude oil supply decreased over 2% to 4,428.7 million barrels during 1974. Production declined almost 5%, exports increased over 57%, and stock withdrawals of 1973 were more than replaced by additions in 1974. The domestic supply of refined petroleum products declined almost 4%. The demand for petroleum was down for each consuming sector. Transportation accounted for more than half of the domestic product demand.

Nuclear Energy.—Nuclear energy consumption during 1974 was 1,202 trillion Btu; this was over 35% greater than the figure for 1973. It increased to 1.6% of total energy consumption for the year; in 1973 it was 1.2% of the total.

Hydropower.—Electricity from hydroelectric plants during 1974 was 3,290 trillion Btu, over 9% greater than in 1973. This was 4.5% of total energy consumption in 1974 compared with 4.0% for 1973.

Other Energy.—Energy sources being used or considered for future use during 1974 included geothermal, oil shale, solar, wind, tidal, and biological (from organic wastes). Geothermal energy was a limited source of energy during 1974; future development depends on the discovery of new fields and their prescribed technology. Work continued on the development of oil shale as a significant source of energy. Solar wind, tidal, and biological energies were only minor or theoretical sources of energy during 1974; their development continued and their potential in the long run is significant.

EMPLOYMENT AND PRODUCTIVITY

Employment.—Employment in almost all of the selected mineral industries increased in 1974. Total mining employment increased over 6%, and within this group employment in metal mining increased 2%, employment in nonmetal mining and quarrying increased almost 3% and employment in the fuel extractive industries increased 8%. In the metal mining group, iron ore mining increased almost 14% and copper ore mining increased a little more than 1%. Within the fuels group, employment in oil and gas field services increased over 13%, employment in crude petroleum and natural gas fields increased almost 8%, employment in bituminous coal increased over 4%, and the only mining employment to decline was in other coal, which was almost 3% less than in 1973.

Total mineral manufacturing employment increased 11% to 963,800 during 1974, mineral manufacturing employment increased almost 13%, and total fuel manufacturing employment increased over 4%. Within the nonfuel minerals group, employment at blast furnaces, steelworks, and rolling mills increased over 16%, nonferrous smelting and refining employment increased over 5%, and the only mineral manufacturing industries to show declines in employment were fertilizers, complete and mixing only, and hydraulic cement, which each decreased over 3%.

Within the fuel manufacturing sector, employment in petroleum refining increased 5%, and employment in other petroleum and coal products increased almost 2%.

Hours and Earnings.—Average hourly earnings in the extractive industries increased nearly 10% for both nonfuels and fuels. The hours worked declined more than 1% in the nonfuels industry and increased almost 3% in the fuels industry, causing average weekly earnings to increase less than 9% for the former while increasing more than 11% for the latter. Within the nonfuels industry average hourly earnings increased 14.1% for metal mining and 8.1% for nonmetallic mining and quarrying, although in both industries the hours worked declined, causing average weekly earnings to increase at a slightly slower rate than that for the hourly figures. Within the metal mining sector, average hourly earnings for iron ores increased over 19%, average weekly hours increased almost 2%, and average weekly earnings increased almost 22%. Average hourly earnings in copper mining increased almost 13%, but average weekly hours declined almost 3%, so average weekly earnings increased less than 10%. In the extractive fuels industries, average hourly earnings in coal mining increased about 9%, and average weekly hours declined about 4%, causing average weekly earnings to increase just over 4%. Average hourly earnings in the crude petroleum and natural gas industries increased almost 14%, average weekly hours increased almost 3%, and average weekly earnings increased almost 17%.

Average hourly and weekly earnings for the manufacturing sector both increased about 11% as weekly hours remained unchanged. Within this group all of the selected industries showed little change in weekly hours. Fertilizers showed increases in hourly and weekly earnings of more than 10%; hydraulic cement, greater than 6%; blast furnaces, steel and rolling mills, more than 14%; nonferrous smelting and refining, nearly 12%; petroleum refining and related industries, nearly 8%; petroleum refining also near 8%; other petroleum and coal products, more than 6%.

Wages and Salaries.—During 1973 (latest data available) total wages and salaries for all industries continued to increase. In the mining sector the increase was almost 10%, and in the manufacturing sector the increase was almost 12%. The average earnings of full-time employees also increased in 1973, but at a slower rate than in 1972. The mining sector employees received an annual average of $11,448, about 7% over 1972. Average earnings in manufacturing increased a little over 6% to $9,758 per year. The average earnings per full-time employee for all industries was $9,106, an almost 6% gain from the 1972 figure.

Labor Turnover Rates.—The accession rate (hires and rehires) during 1974 declined for the manufacturing sector and for most of the nonfuel mineral industries. It increased for nonferrous smelting and refining and for selected fuel industries. In the manufacturing sector the decline was over 12%. The greatest decline was 20% for blast furnaces, steel and rolling mills. The accession rate for nonferrous smelting and refining increased almost 4%, and that for coal mining increased almost 12%. The separation rate increased for manufacturing and for most selected mineral industries; it declined for metal mining and coal mining. In the manufacturing sector the increase was over 4%. The separation rate in the hydraulic cement industry increased almost 38%, for blast furnaces, steel and rolling mills it was almost 10% higher than in 1973, and for nonferrous smelting and refining it was up 4%. The metal mining separation rate declined almost 9%, as did the rate for copper ores; the rate for iron ores was unchanged. The rate for petroleum refining and related industries increased 9%, although for petroleum refining it was unchanged. For coal mining, the separation rate declined almost 19%, the greatest decline among the selected industries. The layoff rate increased two-thirds in manufacturing, more than doubled in hydraulic cement, and increased three-fourths in the blast furnace, steel and rolling mills industry; it remained unchanged in the nonferrous smelting and refining industry. In metal mining the layoff rate remained unchanged, although it declined 20% in the iron ore industry and tripled in the copper ore industry. In petroleum refining and related industries the layoff rate increased two-fifths, although for petroleum refining itself it declined one-fifth. In the coal mining industry it declined by one-third.

Productivity.—Indexes of labor productivity for selected mineral industries for 1973 (latest data available) were mixed. The indexes of output of crude copper ore and of recoverable copper metal mined per employee, production worker, and production worker man-hour all declined at rates between 4% and just over 7%. The same indexes for crude and usable iron ore all increased between just under 5% and just over 11%. The indexes for refined petroleum increased between 7% and 9%; for bituminous coal the index per employee declined over 1%, the index per production worker declined over 2%, and the index per production worker man-hour increased almost 1%.

PRICES AND COSTS

Index of Average Unit Mine Value.—The index of average unit mine value is similar to the index of implicit unit value in that both are designed to show relative price changes of mineral commodities, but it is different in that it is constructed directly from quantity and value data while the index of implicit unit value is the result of dividing two other indexes, a value index and a volume index, which are constructed directly from the data. For further information on the subject, see Bureau of Mines Information Circular 8275.[2]

The index of average unit mine value shows the inflation manifested in mineral prices. The overall average index increased by almost 56% to 212.4 index points. The metals index increased almost 34%, the nonmetals index increased almost 18%, and the fuels index increased almost 69%. In the metals category, the ferrous metals index increased over 27% and the nonferrous metals index increased almost 40%. Base metals prices as reflected in the index, increased 36%; monetary metals, 71%; and other nonferrous metals, almost 28%. In the nonmetals category, the construction index increased 13%, the chemicals index increased 41%, and the other nonmetallic minerals index increased almost 13%. In the fuels category, the index for coal increased almost 77%, and the index for crude oil and natural gas increased almost 66%.

Index of Implicit Unit Value.—The index of implicit unit value (1967=100), as mentioned above, is similar to the index of average unit mine value in that both are intended to show changes in the relative prices of mineral commodities. For this reason it is not surprising that the results of the two indexes are not dissimilar. The overall average for the index of implicit unit value increased over 53% to 209.1 index points. The metals index increased over 33%, the nonmetals index increased over 17%, and the fuels index increased over 68%. In the metals category, the ferrous metals index increased over 27% and the nonferrous metals index increased over 36%. The base metals index increased 34%; monetary metals, 74%; and other nonferrous metals, almost 30%. In the nonmetals category, construction increased almost 13%, chemicals, almost 41%, and other nonmetallic minerals, almost 14%. In the fuels category, coal increased almost 77% and crude oil and natural gas almost 65%.

Prices.—The wholesale price indexes for selected metals, minerals, and fuels (1967=100) all increased significantly in 1974. The index for all commodities increased almost 19% to 160.1 index points; that for all commodities other than farm and food increased over 22% to 153.8 index points. The index for metals and metal products increased more than 29% to 171.9. Many of the indexes for selected metals and metal products increased at about the same magnitude. Exceptions included iron ores, which increased the least, less than 16%; the ones that increased the most were: Iron and steel scrap, almost 88%; slab zinc, which increased almost 70%; aluminum ingot, which increased more than 49%; pig iron and ferroalloys, increasing more than 45%; and primary metal refinery shapes, increasing more than 42%. The index for nonmetallic mineral products increased almost 18% to 153.2 index points. Within the nonmetallic group the indexes all increased between just above 8% for sand, gravel, and crushed stone to almost 131% for phosphate rock. The index for structural clay products increased less than 10%, other nonmetallic minerals increased 47%, phosphates increased more than 58%, fertilizer materials increased more than 61%, nitrogenates increased more than 68%, and bituminous binders increased almost 76%. The price index for fuels and related products and power increased more than 55%. The price indexes for most selected fuels increased at about this magnitude. Exceptions included electric power, which increased a little more than 26%; gas fuels, which increased 28%; crude petroleum, which increased more than 68%; and refined petroleum products, which increased almost 74%.

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[2] Johnson, E. E. Index Numbers for the Mineral Industries. BuMines IC 8275, 1965, 85 pp.

Prices of mineral energy commodities increased substantially during 1974. The average price of bituminous coal at merchant coke ovens increased almost 85% to $36.50 per net ton; the average sales realization prices for anthracite increased between 60% and 71% to between $27.61 and $31.06 per net ton. The average price of crude petroleum at the well increased more than 73% to $6.74 per barrel; the average dealers' price of gasoline excluding taxes increased almost 57% to 30.53 cents per gallon. The average prices of residual fuel oil more than doubled. No. 6 fuel, maximum 1% sulfur, at Philadelphia, was $11.95 per barrel; No. 6 fuel, maximum 0.3% sulfur, at Philadelphia, was $13.11 per barrel; and the average price of bunker C fuel, at all gulf ports, was $9.59 per barrel. The average price of No. 2 distillate fuel oil at Philadelphia almost doubled to 25.26 cents per gallon, and at all gulf ports it increased more than 44% to 29.80 cents per gallon. The average value at the well for natural gas increased almost 41% to 30.4 cents per thousand cubic feet, and at the point of consumption it increased almost 34% to 88.8 cents per thousand cubic feet.

During 1973 (latest data available) the average cost of electrical energy continued to increase at about the same rate as in recent years. Alaska and Hawaii had the highest electricity costs, followed by the New England and Middle Atlantic areas. The lowest cost of electrcial energy was found in the East South-Central region because of the Tennessee Valley Authority. The average cost of electricity in the residential market increased 0.1 cent to 2.4 cents per kilowatt-hour. Most geographic areas increased except the West North-Central, the West South-Central, and the Mountain area which remained the same as in 1972. In the commercial and industrial sectors the average increase in 1973 was 0.1 cent per kilowatt-hour. The only areas to show declines in the cost of electricity in the industrial and commercial sector were the East North-Central and the West North-Central.

Principal Metal Mining Expenses.—The index of principal metal mining expenses (1967=100), following the price trend for the economy as a whole, increased 26% to 171 index points. The labor component and the electrical energy component of the index increased at the same rate as the total index, to 179 and 163 index points, respectively. The supply component increased less than 23% to 157 index points, and the fuel component increased almost 43% to 208 index points.

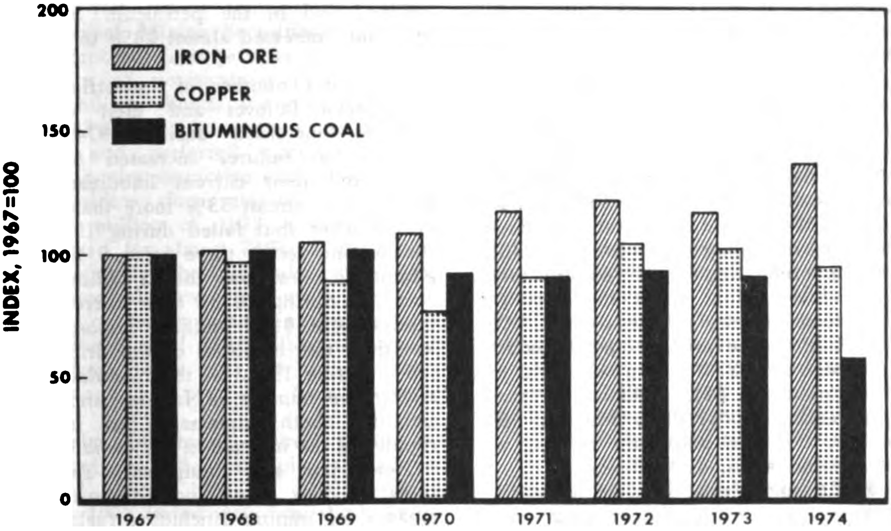

Figure 5.—Index of labor costs per dollar of product.

Costs.—The indexes of relative costs and productivity (1967=100) reflected the inflationary condition that prevailed in the 1974 economy. For iron ore, copper, and bituminous coal, the 1974 indexes of labor costs per unit of output all increased—almost one-third for iron ore, one-fifth for copper, and one-twelfth for bituminous coal. The indexes of value of product per man-period for these commodities also all increased—less than 2% for iron ore, more than one-sixth for copper, and nearly three-fourths for bituminous coal. The index of labor costs per dollar of product increased by more than one-sixth for iron ore, but declined almost 7% for copper and by almost three-eighths for bituminous coal. These figures reflect the mixed impact of inflation on productivity. The petroleum indexes of labor costs per unit of output and of value of product per man-period both increased by about one-tenth during 1973 (latest data available), and the index of labor costs per dollar of product declined almost 4%. During 1972, in the petroleum sector, the index of labor costs per unit of output increased about one-tenth, and the index of value of product per man-period declined slightly, resulting in an increase of about one-tenth in the index of labor costs per dollar of product.

Price indexes for mining construction and material handling machinery and equipment (1967=100) all increased by at least one-tenth during 1974. Five of the nine indexes showed increases of at least one-sixth, with mining machinery and equipment increasing the most. The index for portable air compressors again increased the least.

INCOME AND INVESTMENT

National Income Generated.—In 1973 (latest data available) national income originating in all industries rose almost 13% to $1,066 billion. In the mining sector, crude petroleum and natural gas accounted for the largest share, $4.0 billion. Coal mining accounted for the next largest share of income generated, $2.4 billion, an 8% increase from 1972. Mining and quarrying of nonmetallic minerals increased almost 16% to $1.8 billion. Metal mining showed the largest increase, increasing 23% to $1.2 billion. Income originating in the manufacturing sector increased at about the same rate as mining income, a little over 13%, to $2.9 billion. The primary metals industry accounted for $22.0 billion; chemical and allied products, $21.0 billion; the stone, clay, and glass products industry, $9.9 billion; and the petroleum refining and related industries, $9.4 billion.

Profits and Dividends.—The average annual profit rate on shareholders' equity in all manufacturing industries increased more than two percentage points during 1974 to 14.9%. Of the selected mineral manufacturing industries, only one did not show a substantial increase in its annual profit rate. Stone, clay, and glass products showed a profit rate of 10.6%, which was 0.6 percentage point less than the 1973 figure. The average annual profit rate for primary metals increased almost two-thirds to 16.4%, for primary iron and steel the profit rate increased more than three-fourths to 16.8%, and for primary nonferrous metals the profit rate increased almost one-half to 15.8%. The profit rate for chemicals and allied products increased almost one-fourth to 18.3%; for petroleum it increased more than four-fifths to 21.0%.

Total dividends for all manufacturing increased almost 10% to $19,456 million during 1974. Total dividends increased for all selected mineral manufacturing corporations except primary nonferrous metals, which declined 11% to $483 million. Total dividends for all primary metals increased more than 10% to $1,216 million, and for primary iron and steel they increased more than 31% to $734 million. Total dividends in the stone, clay, and glass products industries increased less than 1% to $450 million; for the chemicals and allied products industries the increase was almost 19% to $2,800 million; and in the petroleum industry dividends increased almost 18% to $4,070 million.

The total number of industrial and commercial failures and their current liabilities increased during 1974. The number of failures increased 6% to 9,915 and their current liabilities were $3.1 billion, almost 33% more than those of the firms that failed during 1973. In the mining sector there were 9 failures, almost 72% less than the 32 failures that occurred during 1973; their current liabilities were $10.1 million, almost 58% less than the liabilities of the firms that failed during 1973. In the manufacturing sector, the number of failures and their liabilities both increased, but not as rapidly as the increase in the overall rates.

New Plant and Equipment.—Expenditures for new plant and equipment increased for mining (including fuels) and for all but one of the selected mineral manufacturing industries. Expenditures by firms in the mining industry increased 16% to $3.18 billion; those by all manufacturing increased 21% to $46.01 billion. Expenditures in the primary iron and steel industry increased almost 54% to $2.12 billion; expenditures in the primary nonferrous metals industry increased almost 40% to $2.33 billion; in the stone, clay, and glass products industry, expenditures declined more than 3% to $1.44 billion; in the chemical and allied products industry, expenditures increased almost 28% to $5.69 billion; and in the petroleum industry expenditures for new plant and equipment increased almost 47% to $8.00 billion.

Plant and equipment expenditures of foreign affiliates of U.S. companies in mining and smelting changed direction in 1974, increasing to $1,252 million. Expenditures decreased only in Canada and remained constant in Europe. Latin American expenditures continued to increase, this year by 47%, reaching $286 million. The remaining areas in the world showed an increase of 65%, a sharp contrast to last year's 29% decrease. In the petroleum sector, plant and equipment expenditures continued to rise in all areas. Expenditures in Europe increased almost 41%, followed by Latin American with 35%. Manufacturing plant and equipment expenditures also rose in 1974. Europe had the largest amount in dollars, $6,316, followed by Canada, $2,122.

Issues of Mining Securities.—Estimated gross proceeds from primary security offerings for all corporations in 1974 were $37.9 billion. Bonds accounted for more than 83% of this; common stock, over 10%; and preferred stock, 6%. Proceeds in the extractive industries totaled $980 million, down almost 9% from the $1,073 million of 1973. Common stock accounted for almost 74% of this figure, and bonds for the remainder; there were no proceeds from preferred stock in 1974. For the manufacturing industries in 1974 the total of $10.4 billion was almost 95% from bonds, over 4% from common stock, and just over 1% from preferred stock.

Foreign Investment.—Direct private investment of U.S. companies abroad increased almost 14% to $107.3 billion during 1973 (latest data available). Petroleum investments were almost 28% of this total, or $29.6 billion, which is nearly a 13% increase from the previous year. In general the percent of petroleum investments received by developing countries was greater than the percent of total investments they received. Petroleum investments in developed countries totaled $16.4 billion. Europe accounted for about one-half of this, and Canada accounted for more than one-third. Petroleum investments in developing countries totaled $10.4 billion. Countries in the Western Hemisphere accounted for more than two-fifths of this, and other Africa and the Middle East each accounted for about one-fifth.

U.S. direct investments in foreign mining increased almost 5% to $7.5 billion during 1973 (latest data available). The developed countries received almost 64% of these investments, or $4.8 billion. More than three-fourths of mining investments in developed countries was in Canada. Mining investments in developing countries were $2.7 billion; almost half of this was invested in Latin American Republics.

The value of foreign direct investments in the United States in 1973 (latest data available) was $17.7 billion, an increase of almost 25%. Investments in the petroleum sector increased almost 37% to $4.4 billion, which is almost 25% of the total foreign direct investments in the United States.

TRANSPORTATION

The total quantity of major minerals and mineral energy products transported by railroad and water during 1973 (latest data available) increased by 60,751 million short tons or almost 4% over that of 1972 to 1.7 billion short tons. Almost 59% of all commodities transported by rail and over 83% of all commodities transported by water were mineral products. The latter represented a small decrease from 1972. About 63% of the selected metals and minerals, except fuels, were transported by rail, and 56% of selected mineral energy resources and related products was transported by water.

In the metals and minerals except fuels category, the volume of commodities transported by rail increased over 11% to 451.9 million short tons. Of this total, almost 60% consisted of four commodities: Iron ore and concentrates, crushed and broken stone, iron and steel ingot, etc., and sand and gravel. Rail transport for almost all of the selected minerals increased in 1973 except for sand and gravel and building cement. The largest increases occurred in gypsum, almost 217%, and nonferrous metal scrap, over 102%. (Note.—In the 1973 chapter of this volume, some of the data for rail transport in 1972 were erroneously reported. The corrected figures are given in this chapter.)

Water transportation of metals and minerals, except fuels, increased almost 6% to 259.9 million short tons. The largest increase by volume occurred in the iron ore and concentrates category, from 73.5 million short tons in 1972 to 84.0 million short tons in 1973, by limestone flux and calcareous stone, which increased from 31.6 million short tons to 36.5 million short tons. In general, water transportation of the selected metals and minerals, excluding fuels, did not show the increases shown by the corresponding rail transportation figures. Almost half of the commodities declined in 1973; the largest decline by volume was in fertilizers and fertilizer materials.

A total of 443.8 million short tons of mineral energy resources and related products was transported by rail in 1973; this was more than 2% greater than 1972. By volume the largest commodity transported was bituminous coal and lignite. This represented almost 84% of the total. The largest increase was a more than 67% increase in crude petroleum.

Water transportation of mineral energy products totaled 567.6 million short tons in 1973, nearly 2% below that of 1972. Again, coal accounted for the largest share of the tonnage transported by water. The largest increase occurred in coke, 56%, and miscellaneous petroleum and coal products, 20%. Decreases of significance occurred in crude petroleum, 13%, and kerosine, 11%.

A total of 967,700 miles of gas pipeline existed in 1973 (latest data available), an almost 2% increase from the 1972 mileage. Total petroleum pipeline mileage in 1974 increased to 222,000 miles from the 1973 level of 219,000 miles. It was distributed among crude gathering systems in field operations, 31%; large-size crude trunklines, 34%; and petroleum product pipelines that extend from refineries to extraction terminals, 35%.

RESEARCH ACTIVITIES

National expenditures for research and development activities by all industries in 1973 (latest data available) totaled $20.9 billion, an 8% increase from the 1972 figure. Of this total, 61% was spent by private industry and 39% by the Federal Government. These proportions were not significantly changed from 1972.

Research and development expenditures in the petroleum refining and extractive industries totaled $504 million in 1973, almost an 8% increase from the 1972 figure of $468 million. Private industry financed 97% of the total research in petroleum refining and extractive industries and 90% of the chemical and allied products industries research. The remainder was financed by the Federal Government. During 1972, private expenditures made up 98% of the total research expenditures in the petroleum refining and extraction industry and 90% of the total research expenditures in the chemical and allied products industry.

Bureau of Mines.—The research program of the Bureau in 1974 continued to emphasize the efficient use of our natural mineral and fuel resources in order to insure adequate mineral supplies without objectionable environmental, social and economic effects. Bureau research concentrated on the following areas: Mining (including health and safety and explosives), metallurgy, resource recovery and pollution abatement, coal, petroleum, oil shale, economics, and helium. During the latter part of 1974, the law establishing ERDA was passed by Congress, and the energy research functions of the Bureau of Mines were to be transferred to that organization.

Bureau of Mines funding obligations for mining and mineral research and development were $66.1 million during fiscal year 1974, almost a 15% decrease from 1973. Funds for applied research decreased by almost $10 million, for basic research the decrease was $1.2 million, and for development the decrease was $463,000. The overall decrease in the Bureau's funding obligations reflected the transfer of some of the research activities that were assigned to ERDA. The obligations for fiscal year 1975 were estimated to be almost double at $116.2 million. Most of this increase was estimated to go towards applied research and development; funds for basic research were estimated to decline in 1975.

Bureau of Mines funding obligations for total research were $30.5 million in 1974, a 26% decrease. Funds for the engineering sciences were $23.9 million; for the physical sciences, $5.3 million; for the mathematical sciences, $0.5 million; and for the environmental sciences, $0.8 million. The estimated figure for total research for 1975 was $53.6 million. Highlights of accomplishments of Bureau research programs, including work in progress, are described in the following pages.

Mining.—The full-scale demonstration of shortwall mining in Kentucky continued during 1974. Using a self-contained powered roof support system, a first shortwall panel in the 54-inch Elkhorn No. 3 coalbed was completed in about 3 months. The 150-foot-wide by 2,400-foot-long panel was mined by a nine-man face crew with an average production of 430 tons per shift. Measurements of ground movement, bed separation, and stress in and around the panel provided information on the effect of shortwall mining on the surrounding rock. One company in the Ohio River Valley successfully used the shortwall system to attain full pillar extraction where less than 50% recovery had been the norm. Under the cooperative agreement, the props and pillars were monitored at this operation during the extraction of four panels.

Work continued on the pumpable, fiberglass-reinforced polymer bolt. Physical properties of a pumpable 1-¾-inch bolt compared favorably with those of a fully resin-grouted steel bolt, and pull-test strength was greater than that developed by mechanical anchor in similar rock. The mechanical problems of replacement were the focus of attention in 1974, and field tests in an eastern and a western coal mine were planned. Principal advantages of the pumpable bolt will be the use of bulk handling methods for materials, amenability to remote placement or automation, adaptability to any length bolt, and particular adaptability for low-coal installation.

Preliminary results of a study of single-entry development for longwall mining indicated that the single entry is more stable, particularly when compared with double-entry intersections. Ventilation studies showed that health and safety standards can be met while driving the single entry. This system will reduce development time and increase coal recovery, thereby reducing costs.

Microseismic instrumentation and techniques used in a western coal mine have proven to offer a means of determining where bounces are most likely to occur and of estimating the overall stability of these areas. Work was continuing to refine these methods and improve their effectiveness. One unstable area was delineated some 2 weeks prior to the occurrence of a large bounce with failure.

Continuous monitoring of an open pit mine in Nevada was being conducted by a computer-controlled microseismic system which detects, records, and triangulates rock noise generated in the pit wall. During March the mine operator was notified that increased microseismic activity had been detected in the north wall and several small cracks had occurred shortly thereafter. The company verified that movement was taking place and took steps to protect or shift the main haulage road. Later in the month this zone failed but caused no delay in mining.

The first field test of electrokinetic densification of hydraulic backfill was conducted at a mine in Idaho. Direct current was applied to hydraulic fill 4 feet deep in a 4- by 90-foot underground opening for 3 hours, consuming 50 kilowatt-hours of power. Slimes, which normally remain soft indefinitely, became hard enough to support men and equipment. After an additional 12 hours (using 280 kilowatt-hours), an average surface hardness of 350 pounds per square inch was achieved. This test demonstrated that unclassified hydraulic backfill can be electrokinetically densified effectively and safely with low power consumption.

Suitable control measures applied to the chain conveyor of a coal loader reduced the noise generated by the machine in an underground coal mine from 108 decibels on the A scale (dbA) to 95 dbA. Fieldworthy muffler and jacket assemblies for pneumatic drills that maintain noise levels at 90 dbA were developed and evaluated. A survey of noise sources in coal preparation plants was completed and suitable control procedures were recommended. The dynamic range of Bureau-developed audio dosimeters was extended to provide coverage down to the 85dbA being considered for new noise standards. A stereo version of the discriminating earmuff was developed that gives the miner the directional information necessary to assess roof noises while providing excellent protection above 90 dbA.

Two prototype passive water barriers developed on the basis of trials in the Bureau's Experimental Mine were found to be effective against dust explosions. The barriers are activated by static pressure forces instead of the usual dynamic wind forces. Novel machine-mounted and portable methane sampling systems were being evaluated underground. The portable system allows a 20-minute gas check at the face without exposing the operator to unsupported roof. Other new instrumentation included a prototype oxygen deficiency alarm that incorporates a rate of change detection for oxygen levels and approved prototype low-velocity anemometers and low-velocity alarms ready for field testing.

The Bureau of Mines, through two research contracts, has developed and field-tested two prototype automatic fire sensing and suppression systems for large mobile vehicles. The systems sense either heat or light from a fire, warn the driver of the hazard, and then automatically extinguish with pressurized B–C class powder. They can also be activated manually by the driver from the cab or at ground level.

As an extension of methane drainage research and in light of current concerns over energy conservation, in January 1974 a multipurpose borehole in West Virginia was connected to a gas transmission line. This borehole has been producing pipeline-quality gas at 600,000 to 700,000 cubic feet per day for almost 2 years. Four horizontal boreholes in the coalbed at the same mine have produced more than 300 million cubic feet of pipeline-quality gas in 330 days.

An experimental procedure was used successfully to drill a degasification hole from the surface, penetrating the coalbed 700 feet below at a glancing angle and continuing into the coalbed for more than 400 feet. This drillhole has produced 25,000 cubic feet of gas per day.

Hydraulic fracturing techniques were used on a borehole in Alabama and produced vertical fractures without harming the overlying rock strata. Gas production from the hole increased from 4,000 cubic feet per day to 50,000 cubic feet per day.

Field studies using a model of a high coal entry containing a continuous miner and a shuttle car showed that with exhaust ventilation, dust concentrations around the operator could be reduced by 99% when the brattice-to-face distance was decreased from 30 feet to 10 feet. Brattice was more effective than tubing in reducing dust when located within 20 feet of the face.

In a study of dust suppression by water sprays, water was found to reduce dust much more effectively when sprayed on the loading pan of the continuous miner than when sprayed on the cutting head.

Satisfactory personal protection has been achieved by incorporating into an ordinary miner's helmet, a blower device that forms a protective curtain of air across the wearer's face. Based on the same principle, the canopies of three mining machines have been equipped with blower devices that surround the operator with a curtain of clean air.

A prototype battery-powered, manually operated rescue and surveillance vehicle for use in postdisaster rescue efforts in underground mines was developed and tested. The vehicle transports a two-man rescue team and has rescue, life support, gas-sensing, and communications equipment and a trailer for transporting two injured miners or supplies.

Development was completed on a new prototype hoist radio system for 10,000-foot-deep shafts that can be quickly deployed in an emergency. The system uses novel circuitry techniques to eliminate the dead spots usually encountered in deep hoist-shaft communication operations.

The trapped miner electromagnetic location system, originally developed for use in coal mines, was modified and performed successfully in hard rock mines to depths up to 4,000 feet. The system may not be usable in all types of mines since the conductivity of the overburden affects the range.

In research on the formation of toxic atmospheres underground, a study of the oxidative thermal degradation of mine conveyor belting and its components indicated that polyvinyl chloride compositions produced the most toxic products and styrene butadiene rubbers, the least. A handbook on sampling methodology for airborne toxic dusts other than coal and silica dusts was prepared as a guide for mine inspectors.

A prototype miniaturized battery-operated device for the simultaneous analysis of carbon dioxide, nitrogen dioxide, and methane successfully detected concentrations of CO and NO_2 at low parts per million levels. A novel method of controlled molecular gas diffusion was used to develop a simple, fairly accurate prototype device for determining exposure to NO_2 on an individual basis in a daily or weekly timeframe. Based on use of selective electrochemical cells, two prototype portable battery-operated instruments were developed that simultaneously monitor CO, NO_2, and O_2 in the underground environment and warn of unsafe levels. A dosimeter was developed that employs a selective permeable membrane to determine time-weighted averages of NO_2 over 6- to 8-hour periods. Performance of the dosimeter was not affected by spatial orientation, a fact which should facilitate personal sampling.

A small solid state radon-daughter dosimeter, operating off a cap lamp battery, gave very satisfactory results in extensive laboratory and field tests. Other monitoring devices in the prototype stage included a moving-belt dosimeter and several diffusion-chamber dosimeters. Development of a high-working-level personal alarm reached the prototype stage.

Over 50 coating materials were tested to determine their ability to stop radon gas emissions. Laboratory tests demonstrated that up to 100% of the radon emanation in uranium ore specimens can be stopped by these coatings. Underground testing of six coatings demonstrated that over 60% of the radon emanation can be stopped. A water-based epoxy and a Saran latex were the easiest materials to spray. The water-based epoxy is also considered safe for use in coal mines to prevent shale degradation.

Guidelines were drawn up for complete mine communication systems, and installation of such systems was begun in a coal mine and a metal mine. The feasibility of monitoring a major air split was demonstrated using a system installed in two sections of an underground coal mine. A miniaturized system for monitoring methane, carbon monoxide, air velocity, temperature, and rate of temperature change was developed and operated with satisfactory results.

Progress in providing candidate illumination systems to implement proposed lighting standards proceeded with successful in-mine evaluations of various portable and machine-mounted luminaires and the development of second-generation-type hardware. Lucalox and fluorescent fixtures were installed on a continuous miner and a loader. A combination of mercury vapor and fluorescent lights was installed on a cutting machine. Fluorescent lighting was provided for a conventional section in a Kentucky mine and on the boom of a continuous miner to supplement existing mercury vapor lights. Fluorescent lighting was installed experimentally at several longwalls to evaluate this type of illumination for this particular application. New hardware that performed successfully in preliminary tests in the field included portable task lamps for both high and low coal to provide supplementary illumination for machine repair and timbering, and a new fluorescent cap lamp that provides improved peripheral vision.

A study was completed on the state of the art of protective canopies, and the minimum size of entry in which a piece of electric face equipment with canopy can be safely operated was defined. In research to equip low-coal machinery with canopies, acceptable versions have been developed for face drills, cutters, and loaders. Design criteria developed for panic bars are providing design guidance to coal mine operators and mine equipment manufacturers. A shuttle car was equipped with automatic steering using guidance sensors developed earlier. Except for a manual input signal to initiate turns, the resulting steering system is completely automated.

A contract study of surface coal-mining operations and surface work areas of underground coal mines produced a detailed analysis of hazardous problems and proposed solutions to reduce or eliminate them. The solutions emphasized equipment design changes, the addition of safety devices or warning systems, and changes in operating practices and procedures.

Long-term demonstrations of equipment and procedures developed through the inherently safe mining systems research program for both conventional and continuous mining were started in 1974. Specific safety innovations on the equipment for the conventional section included rotatable, suspended cabs on the shuttle cars, with automotive-type controls which reverse automatically with the rotation of the cabs. Face drills and cutting machines are equipped with "joysticks" to combine control functions and adjustable cabs. An automated roof-bolting machine, which can be remotely operated from an adjustable protective cab, is used as the section bolter. A drum-type continuous miner has been modified with the addition of four on-board semiautomated roof bolters with magazine storage for up to eight bolts. Protective cabs mounted on the lengthened tailboom provide stations from which the miner and roof bolter operators control their respective functions. An extensible belt system employing one tram (surge) car and several drive storage units completes the continuous face equipment.

A completed study of the feasibility of hydraulic transportation in underground coal mines showed that although a hydraulic haulage system has higher initial costs, it is safer and lower in overall cost than conventional haulage systems. A basic design for a large hydraulic transportation test facility, incorporating 6-, 12-, and 18-inch pipelines with vertical and horizontal sections and including solids size control and multiple-feed capabilities, was completed. In experiments simulating face haulage in different height seams for shortwall and room and pillar mining, continuous-face haulage outproduced shuttle car haulage even when the continuous-mining rate was drastically reduced. Reports of Invention were submitted for a flexible face belt conveyor capable of following either loading or continuous-mining machines and for a feeder operating on a peristaltic action principle for injecting coal into pipelines.

A new conventional mining system was being developed which consists of four closely integrated pieces of equipment. The coal is cut by a unique full-face, twin-auger machine which offers a unique sump-cycle capable of 16 feet of penetration while the operator is always under supported roof. Coal is transported away from the face by a specialized load-haul-dump unit which offers speed, ease of operation, and a design that stresses safety. Coal is discharged at the belt line by a special belt feeder that can easily handle the large car load and can disperse the load at any desired rate. The roof is supported either by a new roof truss system utilizing wire rope or by conventional roof bolts installed by a Roofroper. The four machines together form a complete, safe, and economical system.

In research on incendivity of explosives, the effects of stemming, explosive wrapper, and excessive NO_x production on the probability of ignition of natural gas (W_{50} value) and natural gas-coal dust (W_{cdg} value) atmospheres were investigated. A computer-developed relationship between W_{50} and W_{cdg} and explosives composition was refined to produce results with a correlation coefficient of 0.95 for approximately 50 different explosive formulations.

An underwater test was developed for determining the hazards of marginally explosive material. The test was being considered as a standard by the ASTM. An extensive study yielded preliminary results indicating that blasting agents that are insensitive to a No. 8 blasting cap cannot be initiated by conventional rifle ammunition when unconfined. In research on explosives identification, a method for coating rare-earth phosphors was developed which successfully eliminated their tendency to sensitize certain explosives.

The first two stages of a three-stage prototype borer were fabricated and field-tested. The borer drilled a 24-inch hole in a medium-strength limestone at rates in excess of 21 feet per hour while requiring only 2,500 pounds of thrust. The borer achieved good cuttings removal and sustained no apparent wear or damage. The successful test cleared the way for the fabrication of the third powered stage and the assembly of a complete 42-inch-diameter three-stage prototype borer.

Full-scale field experiments were conducted to determine the effect of relief hole diameter in burn cuts on the length of pull and damage to country rock. Blasting results indicated the following: (1) Void holes of 8-¾- and 12-¼-inch diameters in burn cuts in limestone will pull 20 feet with proper blast design, (2) half-second delays are too slow for use in burn blasting blocky or bedded deposits because they tend to cause cutoffs between relief holes, and (3) visual inspection of the blast zones indicated that, except for the immediate vicinity of the blasts, fracturing occurred along preexisting joint and bedding planes in the limestone.

A new method of hard rock excavation employing high-velocity, smooth bore, 90- and 105-millimeter cannons firing solid concrete projectiles weighing 8 to 12 pounds was successfully demonstrated. This work demonstrated the rock breaking effectiveness of high-velocity projectile impact, the control of tunnel contour while minimizing damage and overbreak, and the development of a silencer able to deenergize and control muzzle blast. It was demonstrated that this is also a viable method for drilling holes, carving out a surface cut, and breaking large boulders.

Metallurgy.—The general objective of the metallurgy program is to provide, through research and development, the scientific and technical information necessary to encourage and stimulate the nonfuel minerals industry to make the expeditious advances in technology that will encourage the industry to produce an adequate supply of mineral raw materials at acceptable material and energy costs, and with a minimum of waste and environmental degradation.

In 1974, the Bureau of Mines operated a miniplant for demonstrating and evaluating processes for the recovery of alumina from domestic nonbauxitic resources. This cooperative project, which had the support and advice of eight domestic and two foreign aluminum companies, was considering five potential processes. Modifications were made to the operating nitric acid miniplant, and construction and installation of the hydrochloric acid miniplant was being completed. Additional installations to evaluate the sulfurous acid, lime-soda sinter, and alunite processes were planned. In other alumina-related work, the chlorination of calcined clay below 1,000°C was found to be too slow and complicated by the production of silicon, iron, and titanium chloride. Higher temperatures produced little improvement in rate and led to severe equipment problems.

An impending worldwide shortage of rutile has led to Bureau-sponsored studies aimed at developing methods to convert domestic ilmenite ($FeTiO_3$) into feed material suitable for pigment-grade titania or titanium metal. Smelting with soda ash recovers over 95% of the iron in ilmenite as high-quality pig iron. The slag is leached to produce a low-iron sodium titanate midproduct that can be used as a superior feed for the sulfate process to yield titania pigment. Mineral synthesis techniques were applied to Idaho and New York ilmenites to yield a high-purity rutile with titanium recoveries ranging from 82% to 96%. Another potential process that was investigated utilized removal of iron by smelting, followed by carbiding the titanium in the slag and chlorination of the carbide. More than 85% of the titanium in ilmenite or perovskite ($CaTiO_3$) was recovered as high-purity titanium tetrachloride.

Increasing attention was being devoted to improving the effectiveness with which energy is used in metallurgical processing. As a basis for this research and development, energy use patterns in the metallurgical and nonmetallic mineral processing industries were the focus of a study funded by the Bureau of Mines. An improved hooding system, which limits the entrance of tempering air into the Bureau-developed continuous ferrous scrap preheater for steelmaking, was developed. The new system produces comparable-ingot-quality carbon steels with lower heat times and lower energy consumption, as compared with conventional batch melting and refining. The thermal efficiency of electric furnace steelmaking also was improved through demonstration of continuous charging and preheating of charge materials. Substitution of alternate fuels for natural gas for indurating iron ore pellets obtained from taconites was under investigation also. Work completed to date in an 800-pound-per-hour, continuous-travelling-grate rotary kiln system has demonstrated the feasibility of firing pellets using Kentucky bituminous coal, Montana subbituminous coal, and a North Dakota lignite as fuels.

The Bureau of Mines developed a process for producing blister copper in a submerged arc furnace from roasted sulfide concentrates. Cement copper also can be processed by electric arc furnace smelting to recover over 98% of the contained copper as blister. Prompt recovery of copper values from mine strip waste may be obtained by sizing the waste and leaching only the coarse fraction. Studies showed that the recovery of copper from copper mining waste could be substantially increased by using oxygen to stimulate the leaching. Progress in the high-current-density electrodeposition of copper in a channel flow-through cell showed that high-quality coherent desposits may be obtained at 300 ampere per square foot. Another potential resource of copper is the Duluth gabbro complex which also contains substantial amounts of nickel. Studies of optimum processes for recovering values from this important national resource were continuing. Process developments were continuing also on the recovery of nickel from the lateritic ores of southern Oregon.

Construction of a commercial flotation mill based on a Bureau-developed potash flotation method for the production of potassium concentrates from low-grade Great Salt Lake evaporites was started. The process produces concentrates containing 14% K_2O from crude salts having a 6% or less K_2O content with 85% of the halite content of the salts being rejected. The new process permits the utilization of low-grade evaporites which previously were returned to the Great Salt Lake. The Bureau continued its cooperative program of testing clay specimens submitted by State geologists. Approximately 500 samples from 23 States were evaluated in 1974. The testing program identifies sources of raw materials for products used by local construction industries.

The Bureau of Mines assisted ERDA by developing improved materials for use in ERDA's Synthane plant, which converts coal to high-Btu gas. Materials were being prepared and tested for use as valve seats, ceramic liners, and Raney nickel catalyst structures. A catalytic conversion step is used to upgrade the low-Btu gas produced by most coal gasification processes into high-Btu, pipeline-quality fuel. The catalyst, known as Raney nickel, is derived from a brittle aluminum-nickel alloy which is applied to the reactor surfaces by flame spraying. This technique is slow and tedious because the only available feed material has been a fabricated plastic rod containing small particles of the alloy. A much improved form of feedstock has been made by using a novel but simple casting technique which produces long, solid rods of the alloy. The rate of flame spraying is 15 times faster with the solid rods than with the conventional feed material.

A method for the production of mischmetal, developed by the Bureau of Mines, has been adopted by industry. The new method, which permits the electrolysis of rare-earth oxides in a rare-earth fluoride bath, is now a viable alternative to the traditional electrolysis of rare-earth chlorides. Small quantities of mischmetal impart superior toughness and bendability to high-strength, low-alloy steels for pipeline and automotive applications.

In less than 2 years the Bureau made notable progress and achieved national recognition in research concerned with solving severe corrosion and scaling problems associated with energy and mineral recovery from geothermal fluids. A variety of select materials, provided by industry, State, and Federal organizations, have been tested in-line at one test well site to determine which metals and alloys will perform satisfactorily in the harsh brine environment. Plans for cooperative geothermal work with the Bureau of Reclamation were underway to make in-line tests at a Bureau of Reclamation test facility.

To provide a process suitable for the production of lead metal by small-volume producers and avoid generating noxious sulfur dioxide, the Bureau was making a feasibility study of winning lead metal by low-temperature, molten-salt lead chloride electrolysis. An aqueous chlorine leach procedure for treating sulfide concentrates is effective in extracting the values. Lead is recovered as the chloride from the leach solution and dried prior to molten salt electrolysis. Zinc also may be recovered as the chloride, and an evaluation of cell design for electrowinning zinc from the chloride was being made. Chlorine, produced in the electrolysis, may be recycled to the concentrate treatment step. The process avoids environmental problems associated with the production of sulfur dioxide.

Research on soldering aluminum has resulted in a method for repairing aluminum air conditioning condensers. Until development of the new method, defective condensers had to be discarded. In the new approach, interfacial corrosion at the solder joint is prevented by using a graded seal of aluminum, zinc, nickel, copper, and tin-lead soldler.

Carbon-in-pulp cyanidation was demonstrated by the Bureau to be useful for recovering silver from low-grade ores and mine wastes. The silver is stripped from the activated carbon, after it is separated from the pulp, by a newly developed alcohol elution technique. After the silver is electrowon from the carbon effluent, the effluent is recycled. Pilot plant work has demonstrated that about 70% of the silver can be recovered from low-grade mill tailings. Information concerning the use of carbon-in-pulp cyanidation is being transferred to small mine operators.

Research in noise damping has developed procedures for reducing noise by 15 dbA during the chipping of castings. Improved muffler design and the use of noise damping alloys also have proven to be effective in significantly reducing underground drilling noise generated by pneumatic rock drills.

Resource Recovery and Pollution Abatement.—The Bureau, in cooperation with the Florida Phosphate Council, continued its efforts to dewater Florida phosphate slimes. The slimes require extensive holding ponds for storage. Attapulgite ($(\mathrm{Mg,Al})_2\mathrm{Si}_4\mathrm{O}_{10}(\mathrm{OH})\cdot 4\mathrm{H}_2\mathrm{O}$) has been identified as a major factor in preventing easy dewatering. Efforts continued to scale up a Bureau-developed settling technique which relies on the slow movement of screens through the slime, compacting the solids, and collecting clear supernatant water above the screen.

Investigations of the utilization of stainless steel wastes such as dust, scale, and swarf have shown that pelletized mixtures can be melted with scrap using ferrosilicon as the reductant in an electric arc furnace to obtain nearly complete recovery of the iron, chromium, nickel, and manganese. Processes also were developed for recycling alkaline cyanide and acid electroplating wastes, spent etching solutions, electrochemical machining sludges, and electroplating sludges. Pelletized mixtures of steelmaking flue dust and coke breeze were tested in a continuous processing furnace to recover zinc metal. The residue contains 65% iron and manganese. Studies were being directed to upgrade the residue so that it will be satisfactory for recycling to an electric furnace.

A simple mineral processing technique was applied by the Bureau to recover sand and brass from used brass foundry molding sands. The procedure has broad application in the brass foundry industry and has been adopted by one foundry. Substantially all of the brass and sand are recovered. In addition to recovery of brass valued at about $60 per ton of mold sand treated, the sand is recycled at an estimated gross savings of $19 per ton.

Asphalt-sand paving material with sulfur additions, developed by the Bureau, was undergoing road testing at Boulder City, Nev. It was found that sulfur can substitute for as much as 75 volume-percent of the binder. In addition to reducing asphalt requirements, the substitution of sulfur allows greater design latitude owing to greater stability under heavy traffic conditions.

In cooperation with a secondary copper producer, a simple mineral processing scheme was developed for recovering copper from copper blast furnace slags generated during smelting of scrap copper. These slags, which contained as much as 100 pounds of copper per ton, were being discarded. Based on the result of this research, the company planned to install a full-scale plant to treat slag from its blast furnace operations.

One phase of the Bureau's research on the abatement of pollution by the minerals industry was directed toward developing low-cost and effective methods for decontaminating, purifying, and conserving mineral processing waste waters. Under this program, a simple procedure was devised which removes trace quantities of selenium, an extremely toxic element, from zinc production plant waste scrubber water. The process was being tested in a continuous process development unit at a zinc plant to obtain engineering and cost data preparatory to installation of units to treat all of the plant water.

The Bureau continued to be in the forefront of research in developing methods for recovering useful components from scrap automobiles. A method was devised in cooperation with two major auto companies to recover polyurethane, which is being used in increasing quantities in newer model autos for padding, seat cushions, and insulation. The use of polyurethane by the auto industry was expected to increase to 600 million pounds in 1975. This is triple the amount used in 1971. Reclaiming the plastic will become increasingly important as more recent model autos are junked, requiring refinement of the technology already developed. Not only will such recovery systems alleviate disposal problems, but valuable petroleum raw materials from which plastics are made will be conserved. Progress was made on upgrading reject scrap from automobile shredders. A water elutriation procedure was developed which yields a 99% metal product representing a recovery of 95% to 99% of the metal content.

A new method for processing lead battery scrap was developed that eliminated nearly all of the sulfur dioxide emission produced when normal reverberatory or blast furnace methods are used. The patented method employs a hydrometallurgical step to convert lead sulfate to lead oxide and $CaSO_4$. The lead oxide is then reduced by carbon, and the $CaSO_4$ is removed with a flux. Lead recoveries were as high as 97%. This promising nonpolluting method has been adopted by industry.

Coal.—In 1974, the Bureau of Mines continued to be deeply involved in its effort to solve the complex energy-environment enigma. The economic production of gasoline and fuels from coal-derived synthesis gas (hydrogen-carbon monoxide mixtures) will be a useful alternative to increased petroleum imports. Developmental work on the conversion of coal to synthetic natural gas (SNG) continued in a small pilot plant as well as in bench-scale units. Studies showed that the production of coal gasifiers may be significantly increased by the addition of suitable materials to the coal in small amounts. The Bureau's effort to develop a process for converting coals into low-sulfur, low ash fuel oils (SYNTHOIL) also continued in 1974. This process uses a turbulent-flow, packed-bed reactor for liquefaction and catalytic hydrodesulfurization of coal. The cost of the fuel compares with that of fuels derived from petroleum. The HYDRANE process, in which coal is reacted with hydrogen to produce methane, has the advantages of utilizing agglomerated coals without treatment as feedstock and also has a high gas output per million Btu of energy in the coal. The overall yields of methane were similar to the calculated design values needed for large-scale operation.

The COSTEAM process converts low-rank coals such as lignite to low-sulfur fuel oil. The oil resembles a heavy No. 6 fuel and has a heating value of about 4,000 Btu per pound. A revolutionary step in coal technology — (UNDERGROUND COAL GASIFICATION) which induces the partial combustion of coal in place to produce a gas that could be burned to produce electricity—was taken by the Bureau in 1974. Successful development of such technology could replace underground mining and thus eliminate the problems associated with it.

In the Bureau's six energy research facilities throughout the United States, additional processes were investigated "to develop effective means that will increase the availability and improve the utilization of the Nation's energy resources at reasonable costs and in a manner that will attain desirable social and environmental improvements." As mentioned previously, Bureau energy research was transferred to ERDA.

Petroleum.—The Bureau's Project Halo was directed at correlating observed gamma-radiation anomalies at the surface of the earth with the presence of hydrocarbon deposits at depth, to determine whether the presence of the anomalies can be used as a technique for petroleum exploration The present work on the project involves sorting different variables to determine which have an immediate and measurable effect upon observed anomalous patterns.

A project involving solvent-extraction and distillation procedures produced experimental quantities of high-quality lubricants from waste crankcase oils, which have good oxidation stability, pass wear and corrosion tests, and meet viscosity requirements. Furthermore, production of potentially polluting byproducts was lower.

In June 1974, the Bureau awarded a multimillion-dollar contract to Cities Service Oil Co. to demonstrate a micellar-polymer flooding technique for tertiary oil recovery. Surfactants and cosurfactants form the active part of micellar fluid; the other part of the fluid is composed of dilute salt water and sometimes crude or refined oil. The final driving fluid will be water.

The Bureau's SolFrac process, which stimulates heavy oil production, uses an explosive fracturing-solvent injection method; the result is the recovery of viscous crude oil. By June 1974, five wells were drilled and shot with explosives, producing 1,151 barrels of solvent-oil mixture containing 91.4 barrels of crude oil.

Another method to recover heavy oil is a process whereby the oil is diluted with a solvent and flows more easily to the producing well. This technological innovation will make possible the recovery of large quantities of oil in the United States, especially California, that cannot be recovered with present technology. The profitability of this method has yet to be proven, however.

Fuel economy in automobiles can be improved by up to 25% using advanced lean combustion engines, including diesels. These innovations are still at the experimental level. The improvement in fuel economy is a result of a compromise between the most stringent proposed standards for emission levels and the 1974 standards. Other experiments suggest that if the most stringent standards are implemented, fuel economy will be further eroded by 1% to 15% from 1974 levels. In terms of the automobiles of the 1960's, it will be a decrease in fuel economy of 30%. Other tests showed that fuel addiives that maintain engine cleanliness and conserve energy have no deleterious effect on the atmosphere.

Oil Shale.—Investigations on the feasibility of producing shale oil by in situ retorting continued in laboratory, pilot plant, and field-scale experiments. The successful development of this process could add significantly to our liquid fuel supplies. Furthermore, this process may prove applicable to deposits of shale that vary in thickness, grade, and depth of burial, many of which may not be readily amenable to mining and above ground retorting. The effect of using steam during retorting was studied, using a 10-ton-capacity batch retort. The results showed that the steam lowered maximum bed temperatures and improved the quality of the offgas, but slightly decreased the recovery of oil.

Other Bureau investigations concerned the occurrence, nature, and evaluation of oil shale deposits in the Green River Formation in Colorado, Utah, and Wyoming. Information was gathered on the extent of these deposits, about variations in oil potential and other characteristics at various locations, and on the possibilities of concurrent production of both minerals and fuels. The Bureau's oil yield data and geology of a part of the Kinney Rim of the Washakie Basin in Wyoming were used to evaluate lease tracts for the production of shale oil.

A Bureau program showed that even though shale oil differs from petroleum, it can be modified to be amenable to commonly practiced petroleum-refining operations. The reduction of sulfur, nitrogen, and oxygen contents of in situ crude shale oils is the primary goal of oil shale refining. This will minimize the pollution of the atmosphere when the final products are used as fuels. Furthermore, the work is intended to provide guidelines in selecting catalysts and operating conditions for future industrial processing of shale oil.

Economic Analysis.—Bureau of Mines economic research activities in 1974 continued to concentrate on economic factors that affect the mineral industries. The purpose of the research was to provide decisionmakers with information and up-to-date analyses of the economic situation, future trends, alternative courses of action, and the impact of choosing any of the alternatives. The economic analysis program attempted to produce the general methodology needed for such studies, as well as information relevant to problem solving in the field of mineral economics. Major long-term research projects in which the Bureau's Division of Economic Analysis was involved included the study and forecasting of demand, supply, and productivity; financial analysis; mineral taxation; waste recycling; input-output analysis; the study of mineral transportation; measures of economic activities stimulated by mineral industries; index numbers; international trade; a weekly price report on minerals and fuels; and a monthly report highlighting major mineral commodities. Some of the short-term projects undertaken in 1974 involved a study of the economic significance of the Florida phosphate industry; assisting in the establishment of an Office of Economic Analysis within the Puerto Rican Department of Natural Resources; a research paper on foreign investment and the changing pattern of mineral supplies; commenting on proposed legislation; a study to estimate the impact of eliminating the percentage depletion allowance on domestic hard minerals; a special detail to the Office of Territories to initiate the preparation of an environmental impact statement on a deepwater port in the Virgin Islands; reviewing the framework to be used as a guideline for the working groups of Project Independence; and monitoring and reporting to governmental policymakers the economic impact of the coal strike.

Helium.—Helium research was directed at production, analytical methods and techniques relating to helium in natural gas, and impurities in purified helium. The Bureau developed a higher grade helium product which provided for a growing need for helium as a heat transfer medium in high-temperature gas reactors (HTGR). Normally high-purity helium contains 100 to 200 parts per billion (ppb) helium-3. Helium-3 can become radioactive in the presence of a radioactive atmosphere. Pure helium-4 is not affected by the radioactivity. The higher grade product developed contains about 20 ppb helium-3; however, 1 ppb helium-3 can be obtained at a reduced production rate and a reduced system efficiency. The Bureau has also developed mass spectrometry techniques to determine the concentration of helium-3 in a sample to a minimum of 1 ppb. This can be used to monitor the Bureau's production of the higher grade helium product containing less than 20 ppb helium-3.

LEGISLATION AND GOVERNMENT PROGRAMS

New and continuing Federal activities dealing with economic stabilization, energy, the environment, resources, and international trade had significant impacts on the minerals sector. The Government continued to use monetary and fiscal tools to fight inflation and promote a stable economy. The Economic Stabilization Act Amendments of 1971 expired early in the year. This act had been the basis for price controls. Since continued use of price controls was not anticipated, the act was allowed to expire.

Energy continued to be a major concern of the Government during 1974. The Arab oil embargo was in effect as the year began. After this embargo was lifted, the price of foreign oil was well above the preembargo level. It was determined that the United States should become more self-sufficient in energy, to offset balance of payment problems and the vulnerability to embargoes. A number of measures to achieve this goal were put forth. These included measures to promote standby domestic capacity and strategic oil reserves for an emergency; to reduce consumption; and to increase production from conventional and new energy resources.

Activities designed to improve the environment, conserve our natural resources, promote public safety, regulate international trade, etc., continued to be important.

Mineral-related legislation enacted into law during 1974 dealt with energy, environmental quality, water, public lands, health and safety, gold and silver, tariffs, and other relevant subjects. Energy was the subject of a large number of laws. Two Federal energy agencies were established. Public Law 93–275 created the Federal Energy Administration (FEA) to deal with energy problems, and Public Law 93–438 consolidated certain Federal energy research functions into ERDA. Three laws were concerned with atomic energy: Public Law 93–377 amended the laws regulating atomic materials, Public Law 93–485 gave the Congress the power to concur in or disapprove international agreements for cooperation with regard to certain nuclear technology, and Public Law 93–514 provided that the Joint Committee on Atomic Energy make an annual report to the Congress on available nuclear information. Three laws passed by Congress promoted energy research and development. Public Law 93–410 was designed to promote the development of geothermal energy, Public Law 93–473 was designed to promote the development of solar energy, and Public Law 93–577 provided Federal support for programs of research and development of fuels and energy.

Environmental quality was also the subject of a significant number of laws. Five laws dealt with the marine environment: Public Law 93–248 implemented the International Convention Relating to Intervention on the High Seas in Cases of Oil Pollution Casualties, Public Law 93–254 implemented the Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter, Public Law 93–472 authorized money for fiscal year 1975 for the implementation of the Marine Protection, Research, and Sanctuaries Act, Public Law 93–513 assured compensation for damages caused by nuclear incidents involving the nuclear reactor of a U.S. warship, and Public Law 93–524 determined that spaces in vessels used for waste materials should be deducted from gross tonnage to determine net tonnage. Public Law 93–278 extended the Environmental Education Act for 3 years, and Public Law 93–319 dealt with the burning of coal at powerplants. Public Law 93–633, which strengthened the laws governing the transportation of hazardous materials, was not signed into law until January 3, 1975. A listing of mineral-related Federal legislation signed into law during 1974 follows:

Public Law (P.L.)	Description	Signed into law
Energy:		
93–275	To create a new Federal Energy Administration.	May 7
93–377	Amending in several respects the atomic energy laws.	Aug. 17
93–410	Authorizing guaranteed loans to finance commercial ventures in the field of geothermal energy, and to coordinate Federal activities in the development of geothermal energy.	Sept. 3
93–438	To consolidate certain functions of Government in a new Energy Research and Development Administration.	Oct. 11

Public Law (P.L.)	Description	Signed into law
93-473	Authorizing funds for Federal programs for research and development of solar energy as a practical means for heating and cooling.	Oct. 26
93-485	Enabling Congress to concur in or disapprove international agreements for cooperation with regard to certain nuclear technology.	Oct. 26
93-511	To extend until August 31, 1975, the Emergency Petroleum Allocation Act.	Dec. 5
93-514	Providing that the Joint Committee on Atomic Energy make an annual report to the Congress on available nuclear information.	Dec. 6
93-577	Providing Federal support for programs of research and development of fuels and energy.	Dec. 31
Environmental quality:		
93-248	Implementing the International Convention Relating to Intervention on the High Seas in Cases of Oil Pollution Casualties, 1969 (Ex. G, 91st Cong., 2d Sess.).	Feb. 5
93-254	To provide for the implementation of the Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter (Ex. C, 93d Cong., 1st Sess.).	Mar. 22
93-278	Extending for 3 years the Environmental Education Act and authorizing funds therefore.	May 10
93-319	Proposed Energy Supply and Environmental Coordination Act of 1974.	June 22
93-472	Authorizing $5.5 million for fiscal year 1975 for the implementation of the Marine Protection, Research and Sanctuaries Act.	Oct. 26
93-513	Assuring compensation for damages caused by nuclear incidents involving the nuclear reactor of a U.S. warship.	Dec. 6
93-524	To deduct from gross tonnage, in determining net tonnage, those spaces in vessels used for waste materials.	Dec. 18
Water resources:		
93-304	Authorizing $5.6 million for U.S. participation in the International Ocean Exposition '75.	June 8
Public lands:		
93-535	To establish the Cascade Head Scenic-Research Area in Oregon.	Dec. 22
Health and safety:		
93-403	Authorizing funds to extend provisions of the Natural Gas Pipeline Safety Act of 1968.	Aug. 30
Gold and silver:		
93-373	To provide for increased participation by the United States in the International Development Association and to permit U.S. citizens to purchase, hold, sell or otherwise deal with gold in the United States or abroad.	Aug. 14
93-463	To strengthen the regulation of futures trading by bringing all agricultural and other commodities traded on exchanges under regulation.	Oct. 23
Tariffs and duties:		
93-470	Providing temporary suspension of duty on synthetic rutile.	Oct. 26
93-497	Continuing suspension of duty on certain forms of copper.	Oct. 29
Miscellaneous:		
93-426	To amend and extend the Defense Production Act.	Sept. 30

The acquisition cost of strategic and critical materials, as of December 31, 1974, totaled $2.7 billion with a market value of $5.7 billion. Materials in these Government inventories with a market value of $6.8 billion were considered to be in excess of stockpile needs. During 1974 the Government disposed of $1.4 billion worth of mineral commodities, 75% more than in 1973. Commodities with greatest sales value consisted of copper with $450 million, tin with $197 million, zinc with $181 million, and aluminum with $177 million. Commodities with sales value of less than $10,000 consisted of antimony, mica (phlogopite block), and talc.

WORLD REVIEW

World Economy.—During 1974, sharp worldwide increases in the price of energy products, food, and other basic materials created new and large payment imbalances for most countries. Consumer prices in industrialized countries rose by about 14%, which was nearly double the average rise in 1972–73. Adding to the pressures of these price increases, world production of foods fell as demand rose.

Early in 1974, policymakers of different industrialized countries were faced with the problems involved in dealing with inflation and a stagnant economy. Real GNP in the industrialized countries, excluding the United States, rose slightly over 1%. The average of the GNP deflators for these countries increased more than 12% compared with an almost 4% annual average increase for the past decade.

In general, the international financial and economic system seemed to adjust well to the disturbances of 1974. Countries refrained from shifting their domestic problems to other countries which resulted in a shrinkage in world trade. Thus the international monetary system was able to cope with the different rates of inflation and the higher energy prices. The Eurodollar market came into public focus as an important means of "recycling petrodollars" by being a channel for the flow of funds from the oil-exporting countries to borrowers.

World Production.—The United Nations (UN) indexes of world mineral industry production (1970=100) increased 4 index points to 118 for the extractive industries during 1974. The metal mining index increased 2 points to 110, the coal index remained unchanged at 96, and the crude petroleum and natural gas index increased 6 points to 127. The mineral processing industries indexes showed a 3-point increase to 122 for base metals, a 3-point increase to 127 for nonmetallic minerals, and a 5-point increase to 134 for chemicals, petroleum, and coal products. Overall industrial production as measured by the UN index rose 5 points to 127 for 1974.

World Trade.—The value of world export trade in all commodities increased almost 38% to $572.7 billion in 1973 (latest data available). For mineral commodities the figure increased almost 43% to $123.9 billion. Metal trade increased over 43% to $56.7 billion; within this group, all ores, concentrates and scrap trade, iron and steel trade, and nonferrous metal trade all followed this same trend. Crude nonmetal trade increased over 30% to $4.2 billion, and trade in mineral fuels increased over 43% to $63.1 billion.

World Prices.—Mineral commodity export prices increased by a magnitude of three during 1974. In the metal ores sector, the price index increased over one-third to 216 index points, and the fuel price index almost tripled to 553 index points. The index for all crude minerals increased almost 164% to 447 index points. Total minerals price increases were stronger in developing areas than in developed areas, although the index for nonferrous base metal prices increased about the same in both areas.

Table 1.—Value of crude mineral production,[1] exports, and imports, by group
(Million dollars)

Mineral group	1970			1971			1972		
	Production	Exports[2]	Imports[2]	Production	Exports[2]	Imports[2]	Production	Exports[2]	Imports[2]
Metals and nonmetals except fuels:									
Nonmetals	5,712	225	551	6,058	226	573	6,482	152	646
Metals	3,928	322	1,249	3,403	192	1,047	3,642	247	988
Total[3]	9,640	547	1,799	9,461	418	1,620	10,124	399	1,634
Mineral fuels	20,152	1,120	1,567	21,247	1,020	2,076	22,061	1,108	2,856
Grand total[3]	29,792	1,667	3,366	30,708	1,438	3,696	32,185	1,508	4,490

Mineral group	1973			1974		
	Production	Exports[2]	Imports[2]	Production	Exports[2]	Imports[2]
Metals and nonmetals except fuels:						
Nonmetals	7,413	280	768	8,682	526	1,158
Metals	4,362	253	r 1,081	5,552	343	1,714
Total[3]	11,775	533	1,849	14,234	869	[4]2,872
Mineral fuels	25,012	1,155	r 4,815	40,921	2,664	16,545
Grand total[3]	36,788	1,688	r 6,664	55,155	3,533	[4]19,417

r Revised.
[1] For details, see the "Statistical Summary" chapter of this volume.
[2] Essentially unprocessed mineral raw material.
[3] Data may not add to totals shown because of independent rounding.
[4] The value of imports for bauxite was not available in 1974.

Table 2.—Value of crude mineral production by group, 1967 constant dollars[1]

(Million dollars)

Mineral group	1970	1971	1972	1973	1974 p
Metals and nonmetals except fuels:					
Nonmetals	5,535	5,646	5,762	6,219	6,215
Metals	3,052	2,742	2,861	3,070	2,928
Total	8,587	8,388	8,623	9,289	9,143
Mineral fuels	18,074	17,735	17,075	17,676	17,186
Grand total	26,661	26,123	25,698	26,965	26,329

p Preliminary.

[1] Value deflated by the index of implicit unit value.

Table 3.—Indexes of the physical volume of mineral production, by group and subgroup[1]

(1967=100)

	1970	1971	1972	1973	1974 p
METALS					
Ferrous	109.3	96.9	98.4	116.0	108.3
Nonferrous:					
Base	167.3	151.0	162.8	166.5	159.3
Monetary	123.9	110.6	102.7	94.5	86.9
Other	119.5	115.5	112.6	114.8	122.3
Average	157.4	143.0	151.1	153.6	143.3
Average, all metals	135.8	122.3	127.5	136.8	130.4
NONMETALS					
Construction	103.1	106.2	111.7	120.8	118.6
Chemical	103.1	101.9	108.7	112.2	121.5
Other	109.1	105.5	112.2	122.7	128.5
Average	103.4	105.2	111.0	119.0	119.7
FUELS					
Coal	108.3	98.9	105.9	105.1	106.7
Crude oil and natural gas	112.0	111.3	111.4	109.3	104.1
Average	111.7	109.7	111.2	109.3	105.4
Average, all minerals	112.1	109.9	112.7	114.1	110.9

p Preliminary.

[1] Historical table of this series in Bureau of Mines Minerals Yearbook of 1971.

Table 4.—Federal Reserve Board indexes of industrial production, mining, and selected minerals and mineral-fuels-related industries

(1967=100)

	1970	1971	1972	1973	1974 p
Mining:					
Coal	105.7	99.8	104.2	104.4	104.8
Oil and gas extraction:					
Crude oil	109.4	108.3	107.3	104.4	100.0
Natural gas	121.4	124.5	126.4	125.9	121.4
Average[1]	109.7	r 108.9	110.0	108.9	107.8
Average coal, oil, and gas	109.2	107.6	109.2	108.3	107.4
Metal	131.3	121.4	120.9	130.8	129.2
Stone and earth minerals	98.8	93.2	98.1	109.5	109.1
Average	112.0	104.6	107.3	118.1	117.2
Average mining	109.7	107.0	108.8	110.3	109.4
Industrial production:					
Primary metals	106.9	100.9	113.1	127.0	124.1
Iron and steel	105.3	r 96.5	107.1	121.7	119.9
Nonferrous metals and products	109.7	108.7	[2]123.6	136.5	132.5
Clay, glass, and stone products	r 106.4	110.0	118.6	129.8	125.5
Average industrial production	r 106.6	106.8	115.2	125.6	124.7

p Preliminary. r Revised.

[1] Includes natural gas liquids and oil and gas drilling.

[2] Corrected figure.

Sources: Federal Reserve System, Board of Governors. Industrial Production, 1971 edition. November 1972, tables A 8–9. Federal Reserve System, Board of Governors. Federal Reserve, Industrial Production. Statistical Releases, Dec. 14, 1973, Dec. 13, 1974, and Mar. 14, 1975.

Table 5.—Federal Reserve Board monthly indexes of mining production, seasonally adjusted

(1967=100)

Month	Total mining[1]		Coal, oil, gas		Coal		Oil and gas extraction[2]				Metal, stone, earth minerals		Metal mining		Stone and earth minerals	
							Total[3]		Crude oil							
	1973	1974	1973	1974	1973	1974	1973	1974	1973	1974	1973	1974	1973	1974	1973	1974
January	108.5	109.9	106.5	107.0	99.1	108.7	107.7	106.8	105.5	102.4	116.4	121.4	130.8	135.2	106.9	111.9
February	110.2	111.7	108.4	109.6	103.9	112.7	109.1	109.1	106.7	104.2	117.6	119.9	131.9	132.2	107.8	111.6
March	109.5	112.2	107.6	110.2	105.7	114.7	107.9	109.5	103.7	101.3	117.0	119.7	127.8	132.9	109.4	110.7
April	109.0	111.3	107.1	109.8	99.9	110.3	108.3	109.7	103.6	100.6	[4] 116.8	117.5	128.5	127.4	108.8	110.7
May	109.1	111.0	107.3	109.2	100.9	112.4	108.4	108.8	104.6	100.2	116.2	117.9	127.0	128.1	108.8	111.0
June	109.5	110.2	108.9	109.7	108.0	118.3	109.1	108.4	104.6	99.8	111.8	112.4	121.6	121.1	105.2	106.4
July	111.0	110.2	109.5	109.4	109.0	115.6	109.5	108.4	105.4	100.4	116.9	113.5	128.4	120.3	109.1	108.8
August	111.5	107.8	109.2	106.7	104.0	99.4	110.0	107.9	104.8	99.5	120.6	109.9	131.4	110.0	113.1	109.9
September	111.8	109.2	[4] 109.6	107.7	109.8	112.1	109.7	107.1	103.9	98.8	120.4	115.4	136.6	130.5	109.5	105.0
October	111.9	110.5	109.7	107.8	103.0	110.3	110.8	107.4	104.2	97.5	120.9	121.3	138.3	141.4	109.2	107.5
November	111.3	105.0	108.8	101.2	104.1	67.6	109.6	106.4	103.7	97.6	121.3	120.7	135.2	136.8	111.7	109.8
December	r 110.4	105.1	r 107.5	102.0	r 110.4	81.7	107.0	105.2	102.9	98.2	122.0	117.9	135.2	134.7	113.1	106.4
Average	110.3	p 109.4	108.3	p 107.4	104.4	p 104.8	108.9	p 107.8	104.4	p 100.0	118.1	p 117.2	130.8	p 129.2	109.5	p 109.1

p Preliminary. r Revised.

[1] Including fuels.

[2] Category changed in source.

[3] Includes natural gas liquids and oil and gas drilling.

[4] Corrected figures.

Source: Federal Reserve System, Board of Governors. Federal Reserve, Industrial Production. Statistical Releases, Feb. 15, 1974, Dec. 13, 1974, and Mar. 14, 1975.

Table 6.—Net supply of principal minerals, by component[1]

(Thousand short tons of mineral content, unless otherwise stated)

Commodity and mineral content measured	Total net supply		Percent change	Components as percent of total, before subtracting exports						Exports as percent of gross supply	
				Primary shipments		Old scrap		Imports			
	1973	1974 p		1973	1974	1973	1974	1973	1974	1973	1974
FERROUS METALS											
Iron ore ---- thousand long tons	131,203	130,691	−0.4	68	64	--	--	32	36	2	2
Pig iron	102,059	96,182	−5.8	100	100	--	--	(2)	(2)	(2)	(2)
Steel ingot	161,447	155,478	−3.7	91	90	--	--	9	10	3	4
Chromite (Cr_2O_3)	433	499	+15.2	--	--	--	--	100	100	5	4
Cobalt ---- thousand pounds	34,052	31,060	−8.8	49	54	--	--	51	46	10	11
Manganese	905	370	−59.1	25	--	--	--	75	100	6	38
Molybdenum ---- thousand pounds	61,597	39,658	−35.6	100	100	--	--	(2)	(2)	55	67
Nickel	219	241	+10.0	7	6	14	12	79	82	9	11
Tungsten ---- thousand pounds	17,803	17,745	−.3	39	41	--	--	61	59	1	6
OTHER METALS											
Aluminum	4,847	5,247	+8.3	84	85	4	4	12	11	10	7
Antimony	45	45	--	1	1	53	50	46	49	1	2
Cadmium ---- short tons	6,099	5,204	−14.7	69	62	--	--	31	38	2	1
Copper	2,595	2,764	+6.5	65	57	18	17	17	26	2	1
Lead	1,409	1,426	+1.2	39	43	43	45	18	12	8	8
Magnesium	105	NA	--	95	W	3	NA	2	NA	27	NA
Mercury ---- 76-pound flasks	58,240	62,196	+6.8	3	4	18	13	79	83	1	1
Platinum group ---- thousand troy ounces	3,975	4,711	+18.5	40	36	6	6	54	58	14	15
Tin ---- thousand long tons	63	51	−19.1	--	--	30	32	70	68	5	14
Titanium concentrate (TiO_2):											
Ilmenite and slag	703	666	−5.3	66	65	--	--	34	35	(2)	(2)
Rutile	209	236	+12.9	--	--	--	--	100	100	--	--
Uranium concentrate (U_3O_8)	19	14	−26.3	68	86	--	--	32	14	--	--
Zinc	1,340	1,340	--	35	37	6	6	59	57	1	1
NONMETALS											
Asbestos	877	824	−6.0	16	13	--	--	84	87	7	6
Barite, crude	1,829	1,871	+2.3	60	59	--	--	40	41	--	--
Bromine ---- thousand pounds	418,250	432,094	+3.3	100	100	--	--	--	--	--	--
Clays	62,771	58,680	−6.5	100	100	--	--	(2)	(2)	3	4
Fluorspar, finished	1,458	1,531	+5.0	17	13	--	--	83	87	(2)	(2)
Gypsum	28,234	25,985	−8.0	73	72	--	--	27	28	(2)	1
Mica (except scrap)	135	115	−14.8	96	94	--	--	4	6	6	7
Phosphate rock (P_2O_5)	9,533	10,660	+11.8	100	99	--	--	(2)	1	32	30
Potash (K_2O equivalent)	5,563	6,084	+9.4	44	37	--	--	56	63	14	11
Salt, common	46,508	49,373	+6.2	93	93	--	--	7	7	1	1
Sand and gravel ---- million tons	984	973	−1.1	100	100	--	--	(2)	(2)	(2)	(2)
Stone, crushed ---- do	1,059	1,042	−1.6	100	100	--	--	(2)	(2)	(2)	(2)
Sulfur, all forms ---- thousand long tons	10,367	10,968	+5.8	90	84	--	--	10	16	15	19
Talc and allied minerals	1,090	1,102	+1.1	98	98	--	--	2	2	14	14

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p Preliminary. NA Not available. W Withheld to avoid disclosing individual company confidential data. Figure is not included in net and gross supply.

[1] Net supply of primary shipments, secondary production, and imports minus exports. Stockpile disposals are included in primary shipments. Gross supply is the total before subtracting exports.

[2] Less than ½ unit.

Table 7.—Shipments, net new orders, and yearend unfilled orders for selected mineral processing industries

(Million dollars)

Year and month	Shipments[1]			Net new orders			Unfilled orders at end of period		
	Primary metals	Blast furnaces	All other primary metals[2]	Primary metals	Blast furnaces	All other primary metals[2]	Primary metals	Blast furnaces	All other primary metals[2]
1970	53,242	25,032	28,210	52,413	24,910	27,503	6,599	3,734	2,865
1971	55,083	26,656	28,427	54,537	26,362	28,175	6,043	3,432	2,611
1972	57,941	28,109	29,832	60,143	29,813	30,330	7,964	5,008	2,956
1973	72,027	35,260	36,767	78,642	39,913	38,729	14,844	9,884	4,960
1974 p	92,365	46,116	46,249	94,667	46,467	48,200	17,202	10,255	6,947
1974:									
January	6,766	3,220	3,546	5,956	2,037	3,919	14,033	8,701	5,332
February	6,884	3,163	3,721	6,624	2,863	3,761	13,773	8,401	5,372
March	7,059	3,420	3,639	6,930	3,037	3,893	13,643	8,019	5,626
April	7,047	3,208	3,839	7,510	3,303	4,207	14,105	8,114	5,992
May	7,421	3,466	3,955	9,002	4,653	4,349	15,688	9,302	6,386
June	7,665	3,600	4,065	9,293	4,922	4,371	17,316	10,624	6,692
July	8,136	4,100	4,036	8,724	4,655	4,069	17,904	11,178	6,726
August	8,474	4,420	4,054	10,010	5,777	4,233	19,438	12,535	6,903
September	8,415	4,448	3,967	8,611	4,414	4,197	19,636	12,501	7,135
October	9,022	4,980	4,042	8,378	4,366	4,012	18,933	11,887	7,046
November	8,572	4,635	3,937	7,863	3,974	3,889	18,286	11,227	7,059
December	7,379	3,954	3,425	6,297	2,982	3,315	17,202	10,255	6,947

p Preliminary.

[1] Monthly figures are seasonally adjusted and may not add to totals.

[2] "All other primary metals" obtained by subtracting blast furnaces from primary metals figures.

Source: U.S. Department of Commerce, Bureau of Economic Analysis. Survey of Current Business. V. 53, No. 2, February 1973, pp. S-5, S-6, S-7; v. 54, No. 2, February 1974, pp. S-5, S-6, S-7; v. 55, No. 3, March 1975, pp. S-5, S-6, S-7.

Table 8.—Index of nonfuel mineral stocks at yearend

(1967=100)

	1970	1971	1972	1973	1974 p
Crude minerals, at producers:					
Metals:	113	147	143	95	78
Iron ore	118	136	113	84	73
Other ferrous	93	275	428	208	130
Nonferrous	99	101	78	63	62
Nonmetals	154	149	138	129	125
Total	131	148	141	110	96
At manufacturers, consumers, and dealers:					
Metals:	106	104	95	85	100
Iron	93	99	88	79	79
Other ferrous	113	135	135	99	102
Base nonferrous	126	109	101	92	117
Other nonferrous	93	96	87	79	111
Nonmetals	101	88	94	91	100
Total	106	103	95	85	100

p Preliminary.

Table 9.—Physical stocks of mineral energy resources and related products at yearend

(Producers' stocks, unless otherwise indicated)

Fuel	1970	1971	1972	1973	1974 [p]
Coal and related products:					
Bituminous coal and lignite [1] short tons	92,275,000	89,985,000	[r] 116,500,000	103,022,000	95,572,000
Coke do	4,113,000	3,510,000	2,941,000	1,184,000	935,000
Petroleum and related products:					
Carbon black thousand pounds	296,087	296,028	237,695	[2] 230,825	293,903
Natural gasoline, plant condensates, and isopentane thousand barrels	7,046	6,176	6,075	7,835	7,550
Crude petroleum and petroleum products [3] do	1,010,815	1,037,771	952,904	1,000,472	1,066,096
Crude petroleum do	276,367	259,648	246,395	242,395	265,020
Gasoline do	214,348	223,771	217,149	209,395	218,346
Special naphthas do	6,193	5,384	5,232	4,514	5,716
Liquefied gases [4] do	67,043	94,713	85,717	83,086	97,956
Distillate fuel oil do	195,271	190,622	154,319	196,421	200,029
Residual fuel oil do	53,994	59,681	55,216	53,480	59,694
Petroleum asphalt do	15,779	21,202	21,636	15,024	21,370
Other products do	181,820	182,750	167,240	196,074	197,965
Natural gas [5] billion cubic feet	3,207	3,523	3,523	3,906	3,969

[p] Preliminary. [r] Revised.

[1] Industrial consumers and retail yards.

[2] Corrected figure.

[3] Includes natural gas liquids.

[4] Includes ethane.

[5] American Gas Association.

Table 10.—Seasonally adjusted book value of product inventories for selected mineral processing industries

(Million dollars)

End of year or month		Petroluem and coal products	Stone, clay, glass products	Primary metals		
				Blast furnace and steel mills	Other primary metals [1]	Total
1970:	December [r]	2,252	2,293	4,951	4,197	9,148
1971:	December	2,367	2,362	4,913	4,306	9,219
1972:	December	2,300	2,463	5,268	4,390	9,658
1973:	December [r]	2,626	2,813	4,672	4,684	9,356
1974:						
	December	3,925	3,721	5,747	6,114	11,861
	January	2,731	2,868	4,691	4,776	9,467
	February	2,868	2,861	4,632	4,891	9,523
	March	3,002	2,952	4,546	5,016	9,562
	April	3,312	3,027	4,542	5,181	9,723
	May	3,355	3,100	4,574	5,373	9,947
	June	3,711	3,210	4,709	5,486	10,195
	July	3,696	3,317	4,855	5,695	10,550
	August	3,820	3,458	4,908	5,795	10,703
	September	3,924	3,552	5,073	5,867	10,940
	October	3,869	3,649	5,172	5,969	11,141
	November	3,892	3,695	5,233	6,057	11,290

[r] Revised.

[1] Other primary metals figure obtained by subtracting blast furnace figure from primary metals figure.

Source: U.S. Department of Commerce, Bureau of Economic Analysis. Survey of Current Business. V. 52, No. 10, October 1972, p. S–6; v. 54, No. 2, February 1974, p. S–6; v. 54, No. 10, October 1974, p. S–6; v. 55, No. 3, March 1974, p. S–6.

Table 11.—Value of selected minerals and mineral products imported and exported by the United States in 1974, by commodity group and commodity [1]

(Thousand dollars)

SITC code [2]		Exports	Imports
	Minerals, nonmetallic (crude):		
271	Fertilizers, crude	257,117	25,247
273	Stone, sand, and gravel	30,095	27,745
274	Sulfur and unroasted iron pyrites	95,727	51,383
275	Natural abrasives (including industrial diamonds)	64,806	65,884
276	Other crude minerals	216,920	267,446
	Total [3]	664,666	487,706
	Metals (crude and scrap):		
281	Iron ore and concentrates	35,148	696,298
282	Iron and steel scrap	848,744	33,669
283	Ores and concentrates of nonferrous base metals	226,955	690,785
284	Nonferrous metal scrap	295,021	205,230
285	Platinum and platinum-group metal ores and concentrates	68,853	211,961
286	Uranium and thorium ores and concentrates	270	200
	Total [3]	1,474,992	1,838,145
	Mineral energy resources and related products:		
321	Coal, coke, and briquets (including peat)	2,487,231	274,365
331	Petroleum, crude and partly refined	13,565	16,482,024
332	Petroleum products, except chemicals	778,090	7,728,118
341	Gas, natural and manufactured	163,476	865,568
	Total [3]	3,442,362	25,350,076
	Chemicals:		
	Inorganic chemicals:		
513	Elements oxides, and halogen salts	507,825	605,677
514	Other inorganic chemicals	326,895	128,144
515	Radioactive and associated materials except uranium and thorium	215,124	130,038
521	Mineral tar, crude chemicals from coal, petroleum, and natural gas	83,797	10,071
	Total [3]	1,133,641	873,930
	Minerals, nonmetallic (manufactured):		
661	Lime, cement, and fabricated building material, except glass and clay	39,808	155,845
662	Clay and refractory construction materials	116,769	82,349
663	Mineral manufactures, not elsewhere specified	170,415	78,651
	Total	326,992	316,845
	Metals (manufactured):		
671	Pig iron, spiegeleisen, sponge iron, iron and steel powder and shot, and ferroalloys	60,703	391,912
672	Iron or steel ingots and other primary forms	187,564	42,978
673	Iron or steel bars, rods, angles, shapes, and sections	357,020	1,545,209
674	Iron or steel universals, plates, or sheets	687,022	2,254,049
675	Iron or steel hoops and strips	141,895	76,239
676	Iron or steel rails and railway track construction materials	40,618	12,199
677	Iron or steel wire (excluding wire rod)	33,553	307,110
678	Iron or steel tubes, pipes, and fittings	852,318	751,239
679	Iron or steel castings or forgings, unworked	199,559	24,391
681	Silver, platinum, and platinum-group metals	199,018	882,573
682	Copper and copper alloys	414,939	1,190,371
683	Nickel and nickel alloys	114,110	493,818
684	Aluminum and aluminum alloys	477,960	382,494
685	Lead and lead alloys	32,685	58,163
686	Zinc and zinc alloys	47,697	458,656
687	Tin and tin alloys	50,925	295,183
688	Uranium and thorium metals and alloys	322	50
689	Miscellaneous nonferrous base metals	162,053	163,511
	Total [3]	4,059,962	9,330,145
	Grand total	11,102,615	38,146,847

[1] Data in this table are for the indicated SITC numbers only, and therefore may not correspond to the figures classified by commodity in the "Statistical Summary" chapter of this volume.

[2] Standard Industrial Trade Classification.

[3] Data may not to totals shown because of independent rounding.

Sources: U.S. Department of Commerce, Bureau of Census. U.S. General Imports. FT 135, December 1974, table 1. U.S. Department of Commerce, Bureau of the Census. U.S. Exports, Commodity and Country FT 410, December 1974, table 1.

Table 12.—Percentage distribution of the value of exports of selected minerals and mineral fuels and related products in 1974, by area of destination

Commodity	North America [1]	South America	Europe, excluding centrally controlled economies	Europe, centrally controlled economies [2]	Asia, excluding centrally controlled economies	Asia, centrally controlled economies [3]	Africa	Oceania	Undesignated area [4]
Fertilizers, crude	27	9	26	2	36	--	--	(5)	(5)
Stone, sand and gravel	81	3	7	(5)	5	--	(5)	1	3
Sulfur and unroasted iron pyrites	2	18	61	10	2	--	--	7	(5)
Natural abrasives, including industrial diamonds	11	6	62	1	13	--	2	4	1
Crude minerals, not elsewhere specified	26	7	42	(5)	19	--	2	3	1
Iron ore and concentrates	86	--	1	--	13	--	--	--	(5)
Iron and steel scrap	16	5	24	(5)	54	1	(5)	(5)	(5)
Ores and concentrates of nonferrous base metals	8	4	61	2	24	--	(5)	1	(5)
Nonferrous metal scrap	14	5	51	(5)	28	--	2	(5)	(5)
Uranium and thorium ores and concentrates	--	--	--	--	--	--	--	--	--
Coke, coal, and briquets, including peat	17	4	25	(5)	54	--	(5)	(5)	(5)
Petroleum, crude and partly refined	100	--	--	--	--	--	--	--	--
Petroleum products, except chemicals	26	11	31	(5)	23	--	5	4	(5)
Gas, natural and manufactured	76	(5)	(5)	--	24	--	--	(5)	(5)
Inorganic chemical elements, oxides, and halogen salts	33	21	17	1	16	--	6	5	1
Other inorganic chemicals	31	16	21	(5)	23	--	4	4	1
Radioactive and associated materials	11	1	60	(5)	27	--	(5)	1	(5)
Mineral tar and crude chemicals from coal, petroleum, and natural gas	21	15	51	--	8	--	3	2	(5)
Lime, cement, and fabricated building materials except glass and clay	54	3	26	2	11	--	1	1	2
Clay and refractory construction materials	54	8	18	3	10	(5)	3	3	1
Mineral manufactures, not elsewhere specified	41	5	31	(5)	14	(5)	2	5	2
Pig iron, sponge iron, iron or steel powders or shot, and ferroalloys	49	8	24	(5)	15	--	1	2	1
Iron and steel ingots and other primary forms	35	35	13	--	15	--	2	(5)	(5)
Iron and steel bars, rods, angles, shapes, and sections	57	18	9	(5)	13	--	2	1	(5)
Iron and steel plates and sheets	36	29	15	2	11	--	5	2	(5)
Iron and steel hoop and strip	30	26	32	--	4	--	3	5	(5)
Iron and steel rails and railway track construction materials	43	51	1	--	3	--	1	(5)	1
Iron and steel wire (except insulated electric)	47	12	23	5	8	--	1	2	2
Iron and steel tubes, pipes, and fittings	25	15	11	1	34	(5)	12	2	(5)
Iron and steel castings and forgings (rough)	83	1	8	1	6	--	--	1	(5)
Silver, platinum, and platinum-group metals	37	3	31	(5)	27	(5)	2	(5)	(5)
Copper and copper alloys	18	15	50	(5)	15	--	1	1	(5)
Nickel and nickel alloys	27	5	54	--	11	--	(5)	2	1
Aluminum and aluminum alloys	40	9	23	1	23	(5)	2	2	(5)
Lead and lead alloys	14	12	55	--	18	--	(5)	(5)	1
Zinc and zinc alloys	15	33	30	--	19	--	1	1	1
Tin and tin alloys	20	6	71	--	2	--	1	(5)	(5)
Uranium and thorium and their alloys	41	--	48	--	8	--	--	--	3
Base metals and alloys not elsewhere specified	20	6	52	(5)	19	--	1	1	1

[1] Includes Trinidad and Netherlands Antilles.
[2] The U.S.S.R., Bulgaria, East Germany, Albania, Czechoslovakia, Hungary, Poland, Romania, and Yugoslavia.
[3] The People's Republic of China, North Korea, and North Vietnam.
[4] Special category exports.
[5] Less than ½ unit.

Source: U.S. Department of Commerce, Bureau of the Census. U.S. Exports, Schedule B, Commodity and Country. FT 410, December 1974, table 2.

Table 13.—Percentage distribution of imports of principal minerals and mineral fuels and related products in 1974, by area of origin

Commodity	North America	South America	Europe, excluding centrally controlled economies	Europe, centrally controlled economies[1]	Asia, excluding centrally controlled economies	Asia, centrally controlled economies[2]	Africa	Oceania
Phosphates, crude and apatite	74	--	--	--	10	--	16	([3])
Gypsum	97	1	1	--	--	--	1	--
Sulfur	100	([3])	([3])	--	--	--	--	--
Natural abrasives	8	--	83	([3])	3	--	6	--
Graphite, natural	28	--	24	11	18	7	12	([3])
Magnesia, refractory and caustic-calcined, and crude magnesite	2	--	87	7	3	--	--	1
Salt	96	3	1	--	([3])	--	--	--
Asbestos	94	([3])	([3])	([3])	--	--	6	--
Mica, including scrap	1	32	--	--	60	--	7	--
Fluorspar	73	--	22	--	1	--	4	--
Barite, crude	24	24	42	--	1	--	9	--
Talc	12	([3])	57	--	30	1	--	([3])
Iron ore and concentrates	49	44	1	([3])	([3])	--	5	1
Iron and steel scrap	93	1	5	--	1	--	([3])	([3])
Copper ores and concentrates	40	20	([3])	--	36	--	--	4
Bauxite	60	33	--	([3])	--	--	7	--
Lead ores and concentrates	55	26	--	--	--	--	--	19
Zinc ores and concentrates	89	6	1	--	3	--	--	1
Tin ores and concentrates	--	100	--	--	--	--	--	--
Manganese ores and concentrates	2	35	--	--	--	--	48	15
Chrome ores	--	--	15	34	20	--	31	--
Tungsten ores and concentrates	19	35	19	--	20	2	4	1
Tantalum, molybdenum, and vanadium ores and concentrates	51	8	12	--	14	--	10	5
Titanium ores and concentrates	13	--	([3])	--	6	--	([3])	81
Zirconium ores	1	--	--	--	4	--	([3])	95
Antimony ores and needles	6	33	8	--	7	--	46	--
Beryllium ores and concentrates	--	57	4	--	--	--	34	5
Columbium ores and concentrates	([3])	61	12	--	14	--	13	--
Copper waste and scrap	69	1	11	([3])	18	--	--	1
Nickel waste and scrap	64	([3])	33	--	2	--	1	([3])
Aluminum waste and scrap	63	1	24	1	10	--	([3])	1
Magnesium waste and scrap	6	--	77	--	13	--	3	1
Lead waste and scrap	100	--	--	--	--	--	--	--
Zinc waste and scrap	82	2	([3])	--		--	--	16
Tin waste and scrap	72	--	6	--	22	--	--	--
Platinum-group metals, ores, concentrates, and waste	27	4	50	([3])	13	--	3	3
Thorium ores and concentrates	--	--	--	--	100	--	--	--
Coal, coke, and briquets	8	([3])	85	4	([3])	--	2	1
Petroleum, crude and partly refined	25	14	1	([3])	32	--	28	--
Petroleum products, except chemicals	49	30	13	2	4	([3])	2	([3])
Gases, natural and manufactured	82	15	1	--	2	--	([3])	--
Mercury, including waste and scrap	54	2	15	8	([3])	--	21	--
Alumina	34	10	5	([3])	([3])	--	--	51
Mineral tar and crude chemicals from coal, petroleum, and natural gas	31	--	62	([3])	7	--	--	--
Potassic fertilizers and fertilizer materials	95	--	2	1	1	--	1	--

[1] The U.S.S.R., Bulgaria, East Germany, Albania, Czechoslovakia, Hungary, Poland, Romania, and Yugoslavia.

[2] The People's Republic of China, North Korea, and North Vietnam.

[3] Less than ½ unit.

Source: U.S. Department of Commerce, Bureau of the Census. U.S. General Imports. FT 135, December 1974, table 2, customs value.

Table 14.—Consumption of major mineral products, mineral fuels, and electricity, 1973, 1974, and projections

Commodity	1973	1974 [p]	2000
MINERAL PRODUCTS			
Ferrous metals:			
Iron ore ... thousand long tons	146,922	188,160	NA
Iron content ... thousand short tons	102,000	[e] 95,900	NA
Raw steel (production) ... thousand short tons	150,799	145,720	NA
Chromite ores (gross weight):			
Metallurgical grade ... do	920	902	NA
Refractory grade ... do	261	294	NA
Chemical grade ... do	206	251	NA
Manganese ore (35% or more Mn) ... do	2,140	1,880	3,900
Molybdenum (Mo content) ... thousand pounds	57,049	68,476	188,000
Tungsten (W content) ... do	15,386	16,298	76,400
Nonferrous metals:			
Aluminum (apparent consumption) thousand short tons	6,507	6,294	28,400
Antimony, primary ... short tons	20,613	18,041	48,000
Copper, refined ... thousand short tons	2,437	2,194	7,100
Lead, primary and secondary ... do	1,541	1,599	2,730
Zinc, all classes ... do	1,932	1,678	3,090
Mercury, primary ... 76-pound flasks	54,283	59,479	102,000
Platinum-group metals ... thousand troy ounces	1,831	1,981	3,157
Silver (industrial consumption) ... do	196,386	177,015	420,000
Ilmenite and titanium slag (estimated TiO_2 content) short tons	678,518	683,533	1,840,000
Uranium (U_3O_8, estimated purchases by private industry) ... do	12,100	11,900	73,113
Nonmetals:			
Asbestos (apparent consumption) thousand short tons	883	846	2,430
Cement (apparent consumption) ... do	90	88	NA
Clays (apparent consumption) ... do	64,814	61,087	174,000
Lime (sold or used) ... do	21,090	21,606	NA
Phosphate rock (P_2O_5 content, apparent consumption) ... do	13,972	14,946	NA
Potash (K_2O content, apparent consumption) do	5,563	6,084	14,455
Salt (apparent consumption) ... do	46,508	49,878	158,900
Sand and gravel ... million short tons	984	979	3,200
Stone, crushed (sold or used) ... do	1,060	1,044	3,400
Sulfur all forms (apparent consumption) thousand long tons	10,234	10,014	30,000
MINERAL ENERGY RESOURCES AND ELECTRICITY			
Bituminous coal ... million short tons	556	551	1,000
Coal carbonized for coke [1] ... do	(94)	(90)	(115)
Anthracite ... do	6	5	2
Petroleum production and natural gas liquids million barrels	6,317	6,070	14,500
Natural gas, dry [2] ... million cubic feet	22,245	21,512	49,000
Electricity generation, net ... million kilowatt hours	1,961,925	1,967,649	NA
Utilities ... do	1,856,216	1,864,961	[3] 8,650,000
Hydropower [4] ... do	285,911	313,141	[3] [5] 605,000
Nuclear power ... do	83,344	112,740	[3] 5,085,000
Conventional fuel-burning plants ... do	1,501,249	1,451,774	[3] 2,960,000
Industrial ... do	105,709	102,442	NA
Total energy resources inputs ... trillion Btu	74,754	73,141	[3] 163,430

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[e] Estimate. [p] Preliminary. NA Not available.

[1] Figures in parentheses are included in the preceding bituminous coal figures.

[2] Residual gas excludes extraction loss but includes transmission loss.

[3] Dupree, W.G., Jr., and J.S. Corsentino, U.S. Energy Through Year 2000 (Revised). U.S. Department of the Interior, December 1975, tables 1 and 15.

[4] Net generations adjusted for net imports or exports. The bulk of net trade is hydropower with an undetermined amount of steam plant power.

[5] Includes power produced at geothermal plants.

Table 15.—Production of mineral energy resources and electricity from hydropower and nuclear power

(Trillion Btu)

Year	Anthracite	Bituminous coal and lignite [1]	Natural gas, wet (unprocessed)	Crude petroleum [2]	Electricity [3]		Total
					Hydropower	Nuclear power	
1970	247	14,820	24,154	r 20,401	2,680	229	r 62,481
1971	222	13,385	24,805	r 20,083	2,825	404	r 61,674
1972	181	14,319	24,792	r 20,041	2,866	576	r 62,775
1973	174	14,208	24,763	19,493	2,860	888	62,386
1974 p	168	14,424	23,689	18,556	3,158	1,202	61,197

p Preliminary. r Revised.

[1] Heat value employed for bituminous coal and lignite follow: 1970, 12,290 Btu per pound; 1971, 12,120 Btu; 1972, 12,025 Btu; 1973, 12,005 Btu; and 1974, 12,000 Btu.

[2] Heat values employed for crude petroleum is 5,800,000 Btu per barrel.

[3] Hydropower and nuclear power include installations owned by manufacturing plants and mines, as well as Government and privately owned public utilities. The fuel equivalent of hydropower and nuclear power is calculated from the kilowatt-hours produced, converted to theoretical energy resources inputs calculated from national average heat rates for fossil-fueled steam-electric plants provided by the Federal Power Commission using 10,494 Btu per net kilowatt-hour in 1970. The heat rate used for hydropower in 1971 is 10,478 Btu per net kilowatt-hour generated; in 1972, 10,379 Btu; and in 1973–74, 10,389 Btu. Energy inputs for nuclear power from 1971 through 1974 are converted at an average heat rate of 10,660 Btu per net kilowatt-hour based on information from the Energy Research and Development Administration.

Table 16.—Calculated gross consumption of mineral energy resources, and electricity from hydropower and nuclear power in British thermal units (Btu) and percent contributed by each [1]

Year	Anthracite	Bituminous coal and lignite	Coke [2]	Natural gas, dry	Petroleum (excluding natural gas liquids)	Natural gas liquids	Electricity		Total
							Hydropower	Nuclear power	
TRILLION BTU									
1970	210	12,488	--	22,029	27,049	2,488	2,650	229	67,143
1971	186	11,857	--	22,819	28,045	2,525	2,862	404	68,698
1972	150	12,278	--	23,035	30,382	2,584	2,946	576	71,946
1973	144	13,150	.	22,712	32,276	2,576	3,008	888	74,754
1974 p	138	13,010	59	22,028	30,935	2,479	3,290	1,202	73,141
PERCENT									
1970	0.3	18.6	--	32.8	40.3	3.7	4.0	0.3	100.0
1971	.3	17.3	--	33.2	40.8	3.7	4.1	.6	100.0
1972	.2	17.1	--	32.0	42.2	3.6	4.1	.8	100.0
1973	.2	17.6	--	30.4	43.2	3.4	4.0	1.2	100.0
1974 p	.2	17.8	0.1	30.1	42.3	3.4	4.5	1.6	100.0

p Preliminary.

[1] Heat values employed follow: Anthracite, 12,700 Btu per pound; and bituminous coal and lignite, weighted average British thermal units provided by the Division of Coal, 12,110 Btu per pound in 1970, 11,980 Btu per pound in 1971, 11,875 Btu per pound in 1972, 11,825 Btu per pound in 1973, and 11,800 Btu per pound in 1974. Weighted average Btu for petroleum products obtained by using 5,248,000 Btu per barrel for gasoline, 5,355,000 for naphtha-type jet fuel, 5,670,000 Btu for kerosine and kerosine-type jet fuel, 5,825,000 Btu for distillate, 6,287,000 Btu for residual, 6,065,000 Btu for lubricants 5,537,000 Btu for wax, 6,636,000 Btu for asphalt, and 5,796,000 Btu for miscellaneous. Natural gas, dry 1,031 Btu per cubic foot in 1970–71; 1,027 Btu in 1972; 1,021 Btu in 1973; and 1,024 Btu in 1974; natural gas liquids, weighted average British thermal units; natural gasoline and other products, 110,000 Btu per gallon; LP 95,500 Btu per gallon; ethane, 73,390 Btu per gallon, and plant condensate, 129,000 Btu per gallon beginning in 1973. Hydropower (adjusted for net imports of electricity) and nuclear power are derived from net electricity gentural gasoline and other products, 110,000 Btu per gallon; LPG 95,500 Btu per gallon; ethane, erated converted to theoretical energy resources input calculated from national average heat rates for fossil fueled steam-electric plants provided by the Federal Power Commission using 10,494 Btu kilowatt-hour generated 10,379 Btu in 1972, and 10,389 Btu in 1973 and 1974. Energy inputs for nuclear power from 1971 through 1974 are converted at an average heat rate of 10,660 Btu per net kilowatt-hour based on information from the Energy Research and Development Administration.

[2] Net imports of coke (2,262,000 tons in 1974). Remainder of coke consumption is accounted for in utilizing gross total Btu value of coal carbonized for coke.

Table 17.—Domestic supply and demand for coal

	1973		1974 [p]	
	Thousand short tons	Trillion Btu	Thousand short tons	Trillion Btu
ANTHRACITE				
Supply:				
Production [1]	6,830	173.5	6,617	168.1
Exports [2]	−1,159	−29.5	−1,169	−29.7
Stock change: Withdrawals (+), additions (−)	NA	NA	NA	NA
Total	5,671	144.0	5,448	138.4
Demand by major consuming sectors: [3]				
Household and commercial [4]	2,917	74.1	2,577	65.5
Industrial [5]	1,312	33.3	1,373	34.9
Electricity generation, utilities	1,442	36.6	1,498	38.0
Total	5,671	144.0	5,448	138.4
BITUMINOUS COAL AND LIGNITE				
Supply:				
Production [1]	591,738	14,207.6	601,000	14,424.0
Exports	−52,903	−1,431.6	−59,926	−1,621.6
Imports	127	3.0	2,080	49.1
Stock change: Withdrawals (+), additions (−)	+14,417	+314.0	+7,221	+141.0
Losses, gains, unaccounted for	2,643	57.0	888	17.3
Total	556,022	13,150.0	551,263	13,009.8
Demand by major consuming sectors:				
Fuel and power:				
Household and commercial [4]	8,200	221.5	8,840	244.4
Industrial [5]	156,448	4,226.1	150,037	4,148.1
Coal carbonized for coke [6]	(93,648)	(2,529.7)	(89,665)	(2,479.0)
Transportation [7]	116	3.1	80	2.2
Electricity generation, utilities	386,879	8,581.0	388,204	8,501.7
Total	551,643	13,031.7	547,161	12,896.4
Raw material: Industrial [8]				
Crude light oil	1,131	30.6	1,087	30.0
Crude coal tar	3,248	87.7	3,015	83.4
Total	4,379	118.3	4,102	113.4
Grand total	556,022	13,150.0	551,263	13,009.8

[p] Preliminary. NA Not available.

[1] Includes use by producers for power and heat.

[2] Includes shipments to U.S. Armed Forces in West Germany.

[3] Except for small quantities used as raw material for coal chemicals, all anthractie is used for fuel and power.

[4] Data represent "retail deliveries to other consumers." These are mainly household and commercial users, with some unknown portion of use by small industries.

[5] Includes consumption by coke plants, steel and rolling mills, and other industrial uses. Adjusted to exclude coal equivalent of raw material use.

[6] Figures in parentheses are not added into totals.

[7] Includes bunkers and military transportation.

[8] Coal equivalent based on British thermal unit value of raw material consumption of coal chemicals listed.

Table 18.—Gross consumption of energy resources, by major sources and consuming sector

(Trillion Btu)

Year	Anthracite	Bituminous coal and lignite	Coke [1]	Natural gas, dry [2]	Petroleum [3]	Hydropower [4]	Nuclear power [4]	Total gross energy inputs [5]	Utility electricity distributed [6]	Total inputs net energy [7]
HOUSEHOLD AND COMMERCIAL										
1970	103	324	--	7,108	6,453	--	--	13,988	3,000	16,988
1971	98	308	--	7,366	6,440	--	--	14,212	3,209	17,421
1972	75	233	--	7,613	6,667	--	--	14,588	3,478	18,066
1973	74	222	--	7,633	6,697	--	--	14,626	3,721	18,347
1974 p	65	244	--	7,518	6,061	--	--	13,888	3,723	17,611
INDUSTRIAL										
1970	59	4,943	--	10,161	5,061	34	--	20,258	2,210	22,468
1971	47	4,256	--	10,570	5,094	34	--	20,001	2,293	22,294
1972	35	4,240	--	10,549	5,668	35	--	20,527	2,493	23,020
1973	33	4,344	--	10,654	6,076	38	--	21,145	2,642	23,787
1974 p	35	4,262	59	10,314	5,907	37	--	20,614	2,665	23,279
TRANSPORTATION [8]										
1970	NA	8	--	745	15,720	--	--	16,473	16	16,489
1971	NA	6	--	766	16,286	--	--	17,058	17	17,075
1972	NA	4	--	787	17,264	--	--	18,055	17	18,072
1973	NA	3	--	744	18,192	--	--	18,939	19	18,958
1974 p	NA	2	--	685	17,720	--	--	18,407	19	18,426
ELECTRICITY GENERATION, UTILITIES [4]										
1970	48	7,213	--	4,015	2,087	2,616	229	16,208	5,226	XX
1971	42	7,288	--	4,117	2,543	2,828	404	17,222	5,519	XX
1972	40	7,796	--	4,086	3,134	2,911	576	18,543	5,988	XX
1973	37	8,581	--	3,681	3,656	2,970	888	19,813	6,382	XX
1974 p	38	8,502	--	3,512	3,480	3,253	1,202	19,987	6,407	XX
MISCELLANEOUS AND UNACCOUNTED FOR										
1970	--	--	--	--	216	--	--	216	XX	216
1971	--	--	--	--	207	--	--	207	XX	207
1972	--	--	--	--	233	--	--	233	XX	233
1973	--	--	--	--	231	--	--	231	XX	231
1974 p	--	--	--	--	246	--	--	246	XX	246
TOTAL ENERGY INPUTS [9]										
1970	210	12,488	--	22,029	29,537	2,650	229	67,143	XX	56,161
1971	186	11,857	--	22,819	30,570	2,862	404	68,698	XX	56,997
1972	150	12,273	--	23,035	32,966	2,946	576	71,946	XX	59,391
1973	144	13,150	--	22,712	34,852	3,008	888	74,754	XX	61,323
1974 p	138	13,010	59	22,028	33,414	3,290	1,202	73,141	XX	59,562

[p]Preliminary. NA Not available. XX Not applicable.

[1] **Net imports of coke (2,262,000 tons in 1974). Remainder of coke consumption is accounted for in utilizing gross total Btu value of coal carbonized for** coke.

[2] Excludes natural gas liquids.

[3] Petroleum products including still gas, LRG, and natural gas liquids.

[4] Represents outputs of hydropower (adjusted for net imports or net exports) and nuclear power converted to theoretical energy inputs calculated from national average heat rates for fossil-fueled steam-electric plants provided by the Federal Power Commission using 10,494 Btu per net kilowatt-hour in 1970. Energy inputs for hydropower in 1971 are converted at an average heat rate of 10,478 Btu per net kilowatt-hour generated; 1972, 10,379 Btu; and 1973–74, 10,389 Btu. Energy inputs for nuclear power in 1971–74 are converted at an average heat rate of 10,660 Btu per net kilowatt-hour based on information from the Energy Research and Development Administration. Excludes inputs for power generated by nonutility fuel-burning plants which are included within the other consuming sectors.

[5] Gross energy is that contained in all types of commercial energy at the time it is incorporated in the economy, whether the energy is produced domestically or imported. Gross energy comprises inputs of primary fuels (or the derivatives) and outputs of hydropower and nuclear power energy converted to theoretical inputs. Gross energy includes energy used for production, processing, and transportation of energy proper.

[6] Utility electricity, generated and imported, distributed to the other consuming sectors as energy resource inputs. Distribution to sectors is based on sales reported in the annual issues of the Edison Electric Institute Yearbook. Conversion of electricity to energy equivalent by sectors was made at the value of contained energy corresponding to 100% efficiency using a theoretical rate of 3,412 Btu per kilowatt-hour.

[7] Energy resource inputs to final consuming sector, including direct fuels and electricity distributed.

[8] Includes bunkers and military uses.

[9] Data may not add to totals shown because of independent rounding.

Table 19.—Domestic supply and demand for natural gas

	1973		1974 p	
	Million cubic feet	Trillion Btu	Million cubic feet	Trillion Btu
Supply:				
Production [1]	22,647,549	24,763.6	21,600,522	23,689.4
Exports	−77,169	−78.8	−76,789	−78.6
Imports	1,032,901	1,054.6	959,284	982.3
Stock change: Withdrawals (+), additions (−)	−441,504	−450.8	−83,663	−85.7
Transfers out, extraction loss [2]	−916,551	−2,576.2	−887,490	−2,479.2
Total	22,245,226	22,712.4	21,511,864	22,028.1
Demand by major consuming sectors:				
Fuel and power:				
Household and commercial [3]	7,476,424	7,633.4	7,341,745	7,517.9
Industrial [4]	9,735,610	9,940.1	9,341,926	9,566.1
Transportation	728,177	743.5	668,792	684.9
Electricity generation, utilities	3,605,333	3,681.0	3,429,231	3,511.5
Total	21,545,544	21,998.0	20,781,694	21,280.4
Raw material: Industrial: [5]				
Carbon black	49,682	50.7	40,130	41.1
Other chemicals [6]	650,000	638.7	690,000	706.6
Total	699,682	714.4	730,130	747.7
Grand total	22,245,226	22,712.4	21,511,864	22,028.1

[p] Preliminary.

[1] Marketed production includes wet gas sold or consumed by producers, losses in transmission, producers' addition to storage, and increases in gas pipeline fill; excludes repressuring and quantities vented and flared. British thermal unit value of production is for wet gas prior to extraction of natural gas liquids. Higher Btu values assigned to extraction loss are reflected in value of natural gas liquids production for each year.

[2] Extraction loss from cycling plants represents offtake of natural gas for natural gas liquids as reported to the Bureau of Mines. Energy equivalent of extraction loss is based on annual outputs of natural gasoline and other products at 110,000 Btu per gallon, annual outputs of LPG at 95,500 Btu per gallon, and annual outputs of ethane at 73,390 Btu per gallon. (Prior to 1967, ethane production was included with LPG in converting to Btu value.) Beginning with 1973, energy equivalent for plant condensate is computed at 129,000 Btu per gallon.

[3] Includes "Other consumers" totals of 308,996 million cubic feet in 1973 and 292,708 million cubic feet in 1974.

[4] Includes transmission losses and unaccounted for of 195,863 million cubic feet in 1973 and 288,731 million cubic feet in 1974.

[5] Includes some fuel and power used by raw material industries.

[6] Estimated from partial data.

NOTE.—Conversion factors for dry gas are 1973, 1,021 Btu per cubic foot; 1974, 1,024 Btu per cubic foot.

Table 20.—Domestic supply and demand for petroleum[1]

	1973		1974 [p]	
	Million barrels	Trillion Btu	Million barrels	Trillion Btu
Supply:				
Crude oil:				
Production	3,360.9	19,493.2	3,199.3	18,556.0
Exports	−0.7	−4.1	−1.1	−6.4
Imports	1,184.0	6,867.2	1,269.2	7,361.4
Stock change: Withdrawals (+), additions (−)	+3.9	+22.6	−22.5	−130.5
Losses, transfers for use as fuel, and unaccounted for	−10.8	−62.6	−16.2	−94.0
Total	4,537.3	26,316.3	4,428.7	25,686.5
Refinery input:				
Crude oil	4,537.3	26,316.3	4,428.7	25,686.5
Transfers in, natural gas liquids[2]	297.5	1,370.9	272.4	1,245.3
Other hydrocarbons	10.7	37.5	13.1	45.9
Total	4,845.5	27,724.7	4,714.2	26,977.7
Refined products:				
Refinery output	4,845.5	27,724.7	4,714.2	26,977.7
Unfinished oil reruns, net	45.8	266.8	37.4	217.9
Processing gain, net	165.4	--	175.2	--
Total	5,056.7	27,991.5	4,926.8	27,195.6
Exports[3]	−83.7	−479.1	−79.4	−460.8
Imports[3]	1,099.5	6,598.5	952.4	5,690.8
Stock change, including natural gas liquids	−53.2	−284.6	−42.8	−231.6
Transfers in, natural gas liquids[2,4]	336.9	1,205.3	343.7	1,233.9
Losses, gains, and unaccounted for	−38.9	−179.3	−31.2	−13.5
Total	6,317.3	34,852.3	6,069.5	33,414.4
Demand by major consuming sectors:				
Fuel and power:				
Household and commercial	977.3	5,433.4	882.2	4,896.1
Industrial	648.2	3,826.0	628.4	3,689.7
Transportation[5]	3,353.7	18,029.1	3,267.9	17,563.7
Electricity generation, utilities	587.4	3,656.0	559.9	3,480.2
Other, not specified	21.1	126.7	18.6	112.2
Total	5,587.7	31,071.2	5,357.0	29,741.9
Raw material:[6]				
Petrochemical feedstock offtake	391.3	1,663.3	386.1	1,640.3
Other nonfuel use	319.4	2,013.5	302.2	1,898.4
Total	710.7	3,676.8	688.3	3,538.7
Miscellaneous and unaccounted for	18.9	104.3	24.2	133.8
Grand total	6,317.3	34,852.3	6,069.5	33,414.4

[p] Preliminary.

[1] Supply and demand for crude oil and petroleum products. Petroleum products refined and processed from crude oil, including still gas and liquefied refinery gas; also natural gas liquids transferred from natural gas.

[2] Btu values for natural gas liquids for each year shown are implicitly derived from weighted averages of major natural gas liquids, with natural gasoline and other products at 110,000 Btu per gallon, liquefied petroleum gases at 95,500 Btu per gallon, ethane at 73,390 Btu per gallon, and plant condensate at 129,000 Btu per gallon.

[3] Btu values for imported and exported refined products for each year shown are based on the average values of the respective products.

[4] Includes natural gas liquids other than those channeled into refinery input as follows: Petrochemical feedstocks, direct uses for fuel and power, and other uses.

[5] Includes bunkers and military transportation.

[6] Includes some fuel and power use by raw materials industries.

Table 21.—Petroleum consumption, by major product and major consuming sector[1]

	Household and commercial		Industrial		Transportation[2]		Electricity generation, utilities		Miscellaneous and unaccounted for		Total domestic product demand	
	Million barrels	Trillion Btu	Million barrels	Trillion Btu	Million barrels	Trillion Btu	Million barrels	Trillion Btu	Million barrels	Trillion Btu	Million barrels	Trillion Btu
1973												
Fuel and power:												
Liquefied gases	186.8	749.3	[3]46.8	187.7	33.6	134.8	--	--	0.2	0.7	267.4	1,072.5
Jet fuels:												
Naphtha type	--	--	--	--	79.2	424.1	--	--	--	--	79.2	424.1
Kerosine type	--	--	--	--	301.1	1,707.3	6.3	35.7	--	--	307.4	1,743.0
Total	--	--	--	--	380.3	2,131.4	6.3	35.7	--	--	386.6	2,167.1
Gasoline	--	--	--	--	2,452.7	12,871.8	--	--	--	--	2,452.7	12,871.8
Kerosine	61.3	347.6	17.6	99.8			--	--	--	--	78.9	447.4
Distillate fuel	536.9	3,127.5	137.7	802.1	370.6	2,158.7	71.6	417.1	11.9	69.3	1,128.7	6,574.7
Residual fuel	192.3	1,209.0	202.9	1,275.6	116.5	782.4	509.5	3,203.2	9.0	56.7	1,030.2	6,476.9
Still gas	--	--	176.8	1,060.8	--	--	--	--	--	--	176.8	1,060.8
Petroleum coke	--	--	66.4	400.0	--	--	--	--	--	--	66.4	400.0
Total	977.3	5,433.4	648.2	3,826.0	3,353.7	18,029.1	597.4	3,656.0	21.1	126.7	5,587.7	31,071.2
Raw material:[4]												
Plant condensate	--	--	1.9	10.3	--	--	--	--	--	--	1.9	10.3
Special naphthas	--	--	32.2	169.0	--	--	--	--	--	--	32.2	169.0
Lubes[5] and waxes	--	--	39.2	234.1	26.9	163.1	--	--	--	--	66.1	397.2
Petroleum coke[6]	--	--	28.8	173.5	--	--	--	--	--	--	28.8	173.5
Asphalt and road oil	190.4	1,263.5	--	--	--	--	--	--	--	--	190.4	1,263.5
Petrochemical feedstock offtake:												
Liquefied refinery gas[7]	--	--	47.2	180.7	--	--	--	--	--	--	47.2	180.7
Liquefied petroleum gas[7 8]	--	--	214.2	756.5	--	--	--	--	--	--	214.2	756.5
Naphtha (−400°)	--	--	56.8	298.1	--	--	--	--	--	--	56.8	298.1
Still gas	--	--	12.4	74.4	--	--	--	--	--	--	12.4	74.4
Miscellaneous (+400°)	--	--	60.7	353.6	--	--	--	--	--	--	60.7	353.6
Total	190.4	1,263.5	493.4	2,250.2	26.9	163.1	--	--			710.7	3,676.8
Miscellaneous and unaccounted for					--	--	--	--	18.9	104.3	18.9	104.3
Grand total, domestic product demand	1,167.7	6,696.9	1,141.6	6,076.2	3,380.6	18,192.2	587.4	3,656.0	40.0	231.0	6,317.3	34,852.3

1974[p]												
Fuel and power:												
Liquefied gases	172.2	690.7	[3] 55.8	223.8	31.2	125.1	--	--	--	--	259.2	1,039.6
Jet fuels:												
Naphtha type	--	--	--	--	81.2	434.8	--	--	--	--	81.2	434.8
Kerosine type	--	--		-	276.2	1,566.0	5.2	29.5	--	--	281.4	1,595.5
Total	--	--	--	--	357.4	2,000.8	5.2	29.5	--	--	362.6	2,030.3
Gasoline	--	--	--	--	2,402.4	12,607.8	--	--	--	--	2,402.4	12,607.8
Kerosine	49.9	282.9	14.5	82.2	--	--	--	--	--	--	64.4	365.1
Distillate fuel	492.7	2,870.0	126.3	735.7	364.2	2,121.5	79.5	463.1	10.1	58.8	1,072.8	6,249.1
Residual fuel	167.4	1,052.5	194.0	1,219.7	112.7	708.5	475.2	2,987.6	8.5	53.4	957.8	6,021.7
Still gas	--	--	175.7	1,054.2	--	--	--	--	--	--	175.7	1,054.2
Petroleum coke	--		62.1	374.1			--	--	--	--	62.1	374.1
Total	882.2	4,896.1	628.4	3,689.7	3,267.9	17,563.7	559.9	3,480.2	18.6	112.2	5,357.0	29,741.9
Raw material:[4]												
Plant condensate	--	--	6.1	33.0	--	--	--	--	--	--	6.1	33.0
Special naphthas	--	--	32.0	167.9			--	--	--	--	32.0	167.9
Lubes[5] and waxes	--	--	37.7	225.1	25.8	156.5	--	--	--	--	63.5	381.6
Petroleum coke[6]			25.0	150.6	--	--	--	--	--	--	25.0	150.6
Asphalt and road oil	175.6	1,165.3	--	--	--	--	--	--	--	--	175.6	1,165.3
Petrochemical feedstock offtake:												
Liquefied refinery gas[7]	--	--	41.9	162.1	--	--	--	--	--	--	41.9	162.1
Liquefied petroleum gas[7,8]	--	--	211.7	739.5	--	--	--	--	--	--	211.7	739.5
Naphtha (—400°)	--	--	61.9	324.9	--	--	--	--	--	--	61.9	324.9
Still gas	--	--	14.4	86.4	--	--	--	--	--	--	14.4	86.4
Miscellaneous (+400°)	--	--	56.2	327.4	--	--	--	--	--	--	56.2	327.4
Total	175.6	1,165.3	486.9	2,216.9	25.8	156.5	--	--	--	--	688.3	3,538.7
Miscellaneous and unaccounted for					--	--	--	--	24.2	133.8	24.2	133.8
Grand total, domestic product demand	1,057.8	6,061.4	1,115.3	5,906.6	3,293.7	17,720.2	559.9	3,480.2	42.8	246.0	6,069.5	33,414.4

[p] Preliminary.

[1] Includes liquefied refinery gas and natural gas liquids.

[2] Includes bunkers, military transportation, and all military use of distillate and residual fuel oils.

[3] Includes secondary recovery of petroleum and agricultural uses.

[4] Includes some fuel and power used by raw materials industries.

[5] Lubricants are distributed on basis of data from Bureau of Census survey.

[6] Includes portions of petroleum coke estimated to be consumed in nonfuel uses.

[7] Includes ethane.

[8] Includes LPG for synthetic rubber.

Table 22.—Electrical energy sales to ultimate consumers

(Million kilowatt-hours)

Region	Total consumption	Residential	Industrial and commercial	Total consumption	Residential	Industrial and commercial
	1970			1971		
New England	55,255	20,900	32,804	59,072	22,870	34,645
Middle Atlantic	201,280	59,709	129,328	208,567	62,878	133,086
East North-Central	267,228	79,687	177,306	281,393	84,629	186,011
West North-Central	90,414	35,339	52,109	94,872	37,872	54,395
South Atlantic	218,715	81,493	128,261	234,920	87,559	137,798
East South-Central	136,728	43,788	90,760	142,057	45,905	93,823
West South-Central	154,136	47,997	99,380	164,047	51,497	105,361
Mountain	62,592	16,977	42,654	66,168	18,641	44,427
Pacific	200,260	60,171	129,739	209,980	65,814	133,615
Alaska and Hawaii	4,801	1,784	2,931	5,365	1,915	3,291
Total United States	1,391,409	447,795	885,272	1,466,441	479,080	926,452
	1972			1973		
New England	63,782	24,614	37,509	68,864	26,169	40,461
Middle Atlantic	219,861	65,978	140,639	235,310	70,729	153,006
East North-Central	304,297	89,736	203,268	331,776	96,164	233,580
West North-Central	100,687	39,074	58,316	108,912	42,146	63,212
South Atlantic	252,811	93,568	149,062	280,103	106,750	163,548
East South-Central	153,430	48,404	102,441	168,890	51,958	114,161
West South-Central	181,902	57,952	116,218	195,624	62,205	125,314
Mountain	71,805	20,609	47,719	77,181	23,375	50,294
Pacific	223,309	69,441	142,551	230,547	72,354	146,584
Alaska and Hawaii	5,830	2,052	3,603	6,496	2,321	3,978
Total United States	1,577,714	511,428	1,001,326	1,703,203	554,171	1,094,138

Source: Edison Electric Institute. Statistical Yearbook of the Electric Utility Industry, 1970–73.

Table 23.—Total employment in selected mineral industries

(Thousands)

	1970	1971	1972	1973	1974
MINING					
Metals:					
Iron ores	26.2	24.5	20.1	21.3	24.2
Copper ores	37.0	34.7	33.9	42.3	42.3
Total[1]	94.8	89.0	86.1	90.5	92.3
Nonmetal mining and quarrying	116.0	113.0	112.1	115.8	119.2
Fuels:					
Bituminous	138.8	132.3	143.2	158.0	165.0
Other coal	5.6	5.4	3.7	3.6	3.5
Crude petroleum and natural gasfields	141.7	141.0	137.8	133.5	143.7
Oil and gasfield services	125.2	120.3	124.1	131.0	148.2
Total	411.3	399.0	408.8	426.1	460.4
Total mining	622.1	601.0	607.0	632.4	671.9
MANUFACTURING					
Minerals:					
Fertilizers, complete and mixing only	40.5	38.2	35.8	38.5	37.3
Cement, hydraulic	34.1	32.0	33.6	33.8	32.7
Blast furnaces, steelworks, and rolling mills	549.6	506.3	492.2	521.8	607.8
Nonferrous smelting and refining	86.3	83.9	83.6	86.3	90.7
Total	710.5	660.4	645.2	680.4	768.5
Fuels:					
Petroleum refining	153.4	153.1	150.8	147.3	154.6
Other petroleum and coal products	38.5	36.7	38.8	[2] 40.0	40.7
Total[3]	191.9	189.8	189.6	[2] 187.3	195.3
Total manufacturing	902.4	850.2	834.8	867.7	963.8

[1] Includes other metal mining not shown separately.
[2] Corrected figure.
[3] Standard Industrial Classification 295, paving and roofing materials, included in total.

Source: U.S. Department of Labor, Bureau of Labor Statistics. Employment and Earnings. Vs. 17–21, March, 1971–75, table B–2.

Table 24.—Average hours and gross earnings of production and related workers in the mineral and mineral fuels industries

	1970	1971	1972	1973	1974
MINING					
Metal:					
Iron ores:					
Weekly earnings	$162.99	$169.70	$185.40	$198.56	$241.43
Weekly hours	41.9	40.5	41.2	42.7	43.5
Hourly earnings	$3.89	$4.19	$4.50	$4.65	$5.55
Copper ores:					
Weekly earnings	$175.67	$178.46	$192.19	$206.52	$226.46
Weekly hours	44.7	42.9	41.6	42.3	41.1
Hourly earnings	$3.93	$4.16	$4.62	$4.88	$5.51
All metal mining:[1]					
Weekly earnings	$165.68	$171.39	$185.51	$200.40	$226.97
Weekly hours	42.7	41.6	41.5	42.1	41.8
Hourly earnings	$3.88	$4.12	$4.47	$4.76	$5.43
Nonmetallic mining and quarrying:					
Weekly earnings	$155.56	$165.23	$176.96	$196.88	$209.28
Weekly hours	44.7	44.9	44.8	47.1	46.3
Hourly earnings	$3.48	$3.68	$3.95	$4.18	$4.52
All mining (excluding fuels):[2]					
Weekly earnings	$160.07	$167.89	$180.61	[3] $195.90	$213.09
Weekly hours	43.8	43.5	43.4	44.0	43.5
Hourly earnings	$3.66	$3.87	$4.17	[3] $4.47	$4.91
Fuels:					
All coal mining:					
Weekly earnings	$183.96	$194.00	$215.88	$226.86	$236.84
Weekly hours	40.7	[4] 40.6	[4] 41.0	39.9	38.2
Hourly earnings	$4.52	[4] $4.79	[4] $5.30	[4] $5.69	$6.20
Bituminous coal:					
Weekly earnings	$186.46	$196.02	$217.46	$228.45	$238.37
Weekly hours	40.8	[4] 40.6	[4] 41.0	39.8	38.2
Hourly earnings	$4.57	[4] $4.85	[4] $5.34	$5.74	$6.24
Crude petroleum and natural gas:					
Weekly earnings	$155.88	$159.75	$169.92	$191.82	$223.86
Weekly hours	40.7	42.6	42.8	40.9	42.0
Hourly earnings	$3.83	$3.75	$3.97	$4.69	$5.33
All fuels:[2]					
Weekly earnings	$166.35	$173.59	$191.27	[3] $201.43	$224.08
Weekly hours	42.1	41.8	41.8	40.8	41.9
Hourly earnings	$3.97	$4.22	$4.58	$4.90	$5.39
MANUFACTURING					
Fertilizers, complete and mixing only:					
Weekly earnings	$123.68	$132.71	$143.14	[3] $155.66	$172.40
Weekly hours	42.5	42.4	42.6	43.0	43.1
Hourly earnings	$2.91	$3.13	$3.36	$3.62	$4.00
Cement, hydraulic:					
Weekly earnings	$176.81	$194.37	$215.37	$233.20	$247.97
Weekly hours	41.8	41.8	42.0	42.4	42.1
Hourly earnings	$4.23	$4.65	$5.12	$5.50	$5.89
Blast furnaces, steel and rolling mills:					
Weekly earnings	$168.38	$181.43	$210.12	$230.74	$263.49
Weekly hours	39.9	39.7	40.8	41.8	41.3
Hourly earnings	$4.22	$4.57	$5.15	$5.56	$6.38
Nonferrous smelting and refining:					
Weekly earnings	$157.63	$166.83	$185.59	$203.46	$227.46
Weekly hours	41.7	41.5	41.8	42.3	42.2
Hourly earnings	$3.78	$4.02	$4.44	$4.81	$5.39
Petroleum refining and related industries:					
Weekly earnings	$182.33	$194.33	$208.89	$220.28	$238.71
Weekly hours	42.7	42.4	42.2	42.2	42.2
Hourly earnings	$4.27	$4.58	$4.95	$5.22	$5.68
Petroleum refining:					
Weekly earnings	$189.93	$202.44	$219.45	$231.02	$250.92
Weekly hours	42.3	42.0	41.8	41.7	42.1
Hourly earnings	$4.49	$4.82	$5.25	$5.54	$5.96
Other petroleum and coal products:					
Weekly earnings	$157.52	$166.44	$175.34	$187.91	$199.67
Weekly hours	44.0	43.8	43.4	43.7	43.5
Hourly earnings	$3.58	$3.80	$4.04	$4.30	$4.59
All manufacturing:[2]					
Weekly earnings	$168.76	$181.46	$206.52	$224.92	$249.72
Weekly hours	40.5	40.4	41.1	41.7	41.7
Hourly earnings	$4.16	$4.49	$5.02	$5.41	$5.99

[1] Includes other metal mining not shown.
[2] Weighted average of data computed using figures for production workers as weights.
[3] Erroneously reported in 1973.
[4] 11-month average.

Source: U.S. Department of Labor, Bureau of Labor Statistics. Employment and Earnings. Vs. 17–21, March 1971–75, table C–2.

Table 25.—Wages, salaries, and average annual earnings in the United States

	1972	1973 p	1974	Percent change 1972–73	Percent change 1973–74
Wages and salaries:					
All industries, total ---------- millions --	$626,781	$691,620	NA	+10.3	NA
Mining ---------------------------- do ----	6,708	7,361	NA	+9.7	NA
Manufacturing ------------------- do ----	175,644	196,585	NA	+11.9	NA
Average earnings per full-time employee:					
All industries, total ----------------------	8,610	9,106	NA	+5.8	NA
Mining -------------------------------------	10,665	11,448	NA	+7.3	NA
Manufacturing -----------------------------	9,201	9,758	NA	+6.1	NA

p Preliminary. NA Not available.

Source: U.S. Department of Commerce, Bureau of Economic Analysis. Survey of Current Business. V. 54, No. 7, July 1974, p. 36, table 6.2; p. 37, table 6.5.

Table 26.—Average labor-turnover rates in selected mineral industries[1]

(Per thousand employees)

Rates and year	Manufacturing	Cement, hydraulic	Blast furnaces, steel and rolling mills	Nonferrous smelting and refining	Metal mining	Iron ores	Copper ores	Petroleum refining and related industries[2]	Petroleum refining	Coal mining
Total accession rate:										
1972 ------	44	16	31	25	34	29	32	18	13	18
1973 ------	48	17	25	26	38	27	39	22	16	17
1974 ------	42	15	20	27	35	26	32	23	17	19
Total separation rate:										
1972 ------	42	16	22	25	35	33	27	20	16	19
1973 ------	46	16	21	25	34	21	34	22	15	16
1974 ------	48	22	23	26	31	21	31	24	15	13
Layoff rate:										
1972 ------	11	5	8	5	3	18	2	6	5	6
1973 ------	9	3	4	4	3	5	1	5	5	3
1974 ------	15	10	7	4	3	4	3	7	4	2

[1] Monthly rates are available in Employment and Earnings as indicated in source.
[2] Standard Industrial Classification 295, paving and roofing materials, included in total.

Source: U.S. Department of Labor, Bureau of Labor Statistics. Employment and Earnings. V. 19–21, No. 9, March 1973–75, table D–2.

Table 27.—Labor productivity indexes for selected minerals

(1967 = 100)

Year	Copper, crude ore mined per—			Iron, crude ore mined per—		
	Employee	Production worker	Production worker man-hour	Employee	Production worker	Production worker man-hour
1969	133.1	125.2	116.2	113.4	116.2	117.8
1970	140.3	131.9	126.9	115.8	117.8	118.0
1971	140.5	136.9	137.2	115.8	119.0	123.4
1972	137.1	130.8	135.2	130.7	135.3	133.1
1973 p	131.6	124.1	126.1	145.2	149.9	147.5
	Copper, recoverable metal mined per—			Iron, usable ore mined per—		
	Employee	Production worker	Production worker man-hour	Employee	Production worker	Production worker man-hour
1969	122.4	115.1	106.9	105.4	108.0	109.6
1970	124.7	117.2	112.8	106.6	108.4	108.7
1971	117.4	114.3	114.6	103.8	106.7	110.6
1972	118.9	108.7	112.4	115.1	119.2	121.6
1973 p	108.8	102.5	104.2	125.5	129.5	127.5
	Petroleum, refined per—			Bituminous coal and lignite mined per—		
	Employee	Production worker	Production worker man-hour	Employee	Production worker	Production worker man-hour
1969	110.7	113.1	110.6	103.3	103.9	105.4
1970	108.4	109.7	108.6	103.1	103.5	103.2
1971	113.1	115.1	115.3	r 93.5	r 97.8	r 98.0
1972	125.5	126.0	126.4	90.4	92.6	92.0
1973 p	136.7	134.7	135.5	89.3	90.5	92.6

p Preliminary. r Revised.

Source: U.S. Department of Labor, Bureau of Labor Statistics. Index of Output per Man-hour; Selected Industries, 1973 edition. BLS Bull. 1827, 1974, tables 2, 4, 6, 8, 12, 46.

Table 28.—Index of average unit mine value of minerals produced

(1967 = 100)

	1970	1971	1972	1973	1974 p
METALS					
Ferrous	109.4	115.9	120.2	125.5	159.5
Nonferrous:					
Base	141.9	129.9	130.7	151.1	205.7
Monetary	109.1	108.8	133.1	222.3	330.2
Other	129.1	130.0	131.2	136.7	174.6
Average	136.4	127.8	131.5	155.5	217.3
Average all metals	122.1	121.5	125.5	139.6	186.7
NONMETALS					
Construction	107.8	112.7	120.8	127.2	143.6
Chemical	87.2	86.2	85.2	91.1	128.5
Other	108.5	115.7	123.4	132.5	149.2
Average	103.2	106.9	113.0	119.4	140.5
FUELS					
Coal	135.4	152.9	165.2	183.3	324.2
Crude oil and natural gas	108.5	115.6	116.4	133.8	221.6
Average	111.8	120.6	123.4	141.6	233.8
Overall average	110.7	117.6	121.2	136.4	212.4

p Preliminary.

Table 29.—Index of implicit unit value of minerals produced

(1967 = 100)

	1970	1971	1972	1973	1974 p
METALS					
Ferrous	109.1	115.6	119.5	123.7	157.5
Nonferrous:					
Base	143.4	130.1	130.6	151.0	202.4
Monetary	109.5	107.9	136.2	212.2	369.4
Other	129.7	132.0	136.4	141.3	183.1
Average	139.8	128.7	131.4	153.3	208.7
Average all metals	128.7	124.1	127.3	142.1	189.6
NONMETALS					
Construction	107.7	112.8	120.6	127.0	143.3
Chemical	87.4	86.9	84.6	90.2	126.8
Other	108.8	115.2	119.8	128.0	145.6
Average	103.2	107.3	112.5	119.2	139.7
FUELS					
Coal	135.4	152.9	165.5	183.5	324.3
Crude oil and natural gas	108.5	115.5	116.4	133.8	220.2
Average	111.5	119.8	129.2	141.5	238.1
Overall average	111.8	117.6	121.2	136.4	209.1

p Preliminary.

Table 30.—Price indexes for selected metals, minerals, and fuels

(1967=100)

Commodity	Annual average		Percent change from 1973
	1973	1974	
Metals and metal products	132.8	171.9	+29.4
Iron and steel	136.2	178.6	+31.1
Iron ore	106.7	123.3	+15.6
Iron and steel scrap	188.0	353.2	+87.9
Semifinished steel products	133.9	169.0	+26.2
Finished steel products	134.1	170.0	+26.8
Foundry and forge shop products	131.5	161.4	+22.7
Pig iron and ferroalloys	129.4	188.1	+45.4
Nonferrous metals	135.0	187.1	+38.6
Primary metal refinery shapes	139.1	197.7	+42.1
Aluminum ingot	101.5	151.3	+49.1
Lead, pig, common	117.0	159.1	+36.0
Zinc, slab, prime western	146.7	249.2	+69.9
Nonferrous scrap	148.4	197.5	+33.1
Nonmetallic mineral products	130.2	153.2	+17.7
Concrete ingredients	131.2	148.7	+13.3
Sand, gravel, and crushed stone	125.0	135.2	+8.2
Structural clay products	123.3	135.2	+9.7
Gypsum products	120.9	137.6	+13.8
Other nonmetallic minerals	128.4	188.7	+47.0
Building lime	126.9	152.6	+20.3
Insulation materials	137.4	156.5	+13.9
Bituminous binders	126.2	222.0	+75.9
Fertilizer materials	77.1	124.2	+61.1
Nitrogenates	75.5	126.9	+68.1
Phosphates	75.0	118.6	+58.1
Phosphate rock	79.8	184.2	+130.8
Potash	105.7	132.6	+25.4
Fuels and related products and power	r 134.3	208.3	+55.1
Coal	218.1	332.4	+52.4
Anthracite	166.9	247.3	+48.2
Bituminous	222.5	339.5	+52.6
Coke	166.6	247.7	+48.7
Gas fuels	126.7	162.2	+28.0
Electric power	129.3	163.1	+26.1
Petroleum products, refined	r 128.7	223.4	+73.6
Crude petroleum [1]	126.0	211.8	+68.1
All commodities other than farm and food	r 125.9	153.8	+22.2
All commodities	r 134.7	160.1	+18.9

r Revised.

[1] Includes only domestic production.

Source: U.S. Department of Labor, Bureau of Labor Statistics. Wholesale Prices and Price Indexes. Supplement 1974, January 1975, table 5; January–December 1974, table 6.

Table 31.—Comparative mineral energy resource prices

Fuel	1972	1973	1974
Bituminous coal: Average prices cost of coal at merchant coke ovens dollars per net ton	17.67	19.77	p 36.50
Anthracite, average sales realization per net ton at preparation plants, excluding dredge coal:			
Chestnut dollars	17.66	19.30	p 31.06
Pea do	15.72	16.98	p 27.61
Buckwheat No. 1 do	15.38	16.61	p 28.36
Petroleum and petroleum products:[1]			
Crude petroleum, average price per barrel at well do	3.39	3.89	6.74
Gasoline, average dealers' net price (excluding taxes) of gasoline in 55 U.S. cities cents per gallon	17.72	19.48	30.58
Residual fuel oil:			
No. 6 fuel, maximum 1% sulfur, average of high and low prices at Philadelphia[2] dollars per barrel	[3] 4.08	[3] 4.85	11.95
No. 6 fuel, maximum 0.3% sulfur, at Philadelphia[2] do	[4] 4.36	5.68	13.11
Bunker C, average of high and low prices for all gulf ports do	2.05	3.42	9.59
Distillate fuel oil:			
No. 2 distillate, average of high and low prices at Philadelphia cents per gallon	11.75	[3] 12.67	25.26
No. 2 distillate, average price for all gulf ports do	10.10	20.65	29.80
Natural gas:			
Average U.S. value at well cents per thousand cubic feet	18.6	21.6	30.4
Average U.S. value at point of consumption do	62.1	66.5	83.8

p Preliminary.

[1] Petroleum products from Platt's Oil Price Handbook.

[2] Prices at refineries and terminals in cargoes.

[3] Erroneously reported in previous year.

[4] New York Harbor.

Table 32.—Cost of fuel in steam-electrical power generation

(Cents per million Btu)

Region	1971			1972			1973		
	Coal	Oil	Gas	Coal	Oil	Gas	Coal	Oil	Gas
New England	48.8	47.6	45.5	49.7	55.5	46.1	52.1	72.8	52.5
Middle Atlantic	40.9	57.1	44.9	42.1	62.3	58.1	47.4	80.0	62.4
East North-Central	35.5	63.2	42.9	33.9	68.0	51.6	42.9	78.4	58.2
West North-Central	31.6	70.3	28.3	34.0	69.9	29.9	36.9	81.6	34.6
South Atlantic	41.8	43.3	39.7	42.6	49.6	39.9	45.6	62.9	45.1
East South-Central	29.2	49.6	27.9	32.5	72.4	29.9	36.3	94.7	38.5
West South-Central	17.8	59.8	22.2	21.0	67.2	24.2	13.1	89.0	28.2
Mountain	20.9	40.4	32.4	22.7	58.2	35.1	25.1	95.9	39.1
Pacific	--	55.4	34.6	--	73.9	37.5	31.8	88.1	41.9
United States	36.0	51.5	28.8	33.2	58.8	30.3	41.4	75.9	34.1

Source: National Coal Association. Steam-Electric Plant Factors. 1972 through 1974, table 2.

Table 33.—Cost of electrical energy

(Cents per kilowatt-hour)

	1971			1972			1973		
	Total	Residential	Commercial and industrial	Total	Residential	Commercial and industrial	Total	Residential	Commercial and industrial
New England	2.3	2.7	2.0	2.5	2.9	2.2	2.6	3.1	2.3
Middle Atlantic	2.2	2.9	1.9	2.4	3.0	2.0	2.5	3.2	2.2
East North-Central	1.8	2.4	1.5	1.9	2.5	1.7	1.9	2.6	1.6
West North-Central	2.0	2.5	1.7	2.1	2.5	1.9	2.1	2.5	1.8
South Atlantic	1.6	2.0	1.4	1.8	2.1	1.5	1.9	2.2	1.6
East South-Central	1.2	1.5	1.0	1.2	1.6	1.0	1.3	1.7	1.1
West South-Central	1.5	2.1	1.2	1.5	2.2	1.2	1.6	2.2	1.3
Mountain	1.5	2.1	1.3	1.6	2.2	1.4	1.7	2.2	1.5
Pacific	1.3	1.7	1.1	1.4	1.8	1.2	1.5	1.9	1.3
Alaska and Hawaii	2.5	2.9	2.2	2.6	3.0	2.3	2.7	3.1	2.5
United States	1.7	2.2	1.4	1.8	2.3	1.5	1.9	2.4	1.6

Source: Edison Electric Institute, Statistical Yearbook of the Electric Utilities Industry. 1971 through 1973, based on tables 22–S and 36–S.

Table 34.—Price index of principal metal mining expenses [1]

(1967=100)

Year	Total	Labor	Supplies	Fuel	Electrical energy
1970	[r] 111	[r] 113	111	106	105
1971	[r] 119	[r] 123	116	114	114
1972	[r] 127	[r] 133	120	119	122
1973	[r] 136	[r] 142	128	146	129
1974 [p]	171	179	157	208	163

[p] Preliminary. [r] Revised due to methodology change.

[1] Indexes constructed using the following weights derived from the 1967 Census of Mineral Industries: Labor 50.04; explosives, 3.18; steel mill shapes and forms, 7.32; all other supplies, 26.89; fuels, 5.88; electric energy, 6.69; and data from U.S. Department of Labor, Bureau of Labor Statistics, Wholesale Prices and Price Indexes. The index is computed for iron and copper ores only because sufficient data are not available for other mining sectors.

Table 35.—Index of major input expenses for bituminous coal and crude petroleum and natural gas mining [1]

(1967=100)

Year	Bituminous coal	Crude petroleum and natural gas
1970	119	108
1971	129	114
1972	141	122
1973	155	136
1974 [p]	178	NA

[p] Preliminary. NA Not available.

[1] Indexes constructed by using data from the U.S. Department of Labor, Bureau of Labor Statistics, Wholesale Prices and Price Indexes, annual and monthly, and weights derived from data shown in the 1967 Census of Mineral Industries, U.S. Department of Commerce, Bureau of the Census. Weights used are as follows: For bituminous coal—labor, 61.55; explosives, 2.70; steel mill shapes and forms, 5.08; all other supplies, 24.58; fuels, 1.74; electric energy, 4.35; and for crude petroleum and natural gas—labor, 44.65; supplies, 48.79; fuels, 2.07; and electric energy, 4.49.

Table 36.—Indexes of relative costs and productivity for iron ore, copper, bituminous coal, and petroleum mining[1]

(1967 = 100)

Year	Iron ore[2] [3]	Copper[2] [3]	Bituminous coal	Petroleum
INDEX OF LABOR COSTS PER UNIT OF OUTPUT				
1970	r 112	r 115	125	107
1971	r 123	r 122	133	114
1972	r 128	r 133	154	127
1973	r 130	r 155	170	140
1974 p	172	187	185	NA
INDEX OF VALUE OF PRODUCT PER MAN-PERIOD				
1970	r 108	r 159	133	124
1971	r 109	r 141	144	132
1972	r 113	r 136	153	129
1973	r 122	r 149	169	143
1974 p	124	175	292	NA
INDEX OF LABOR COSTS PER DOLLAR OF PRODUCT				
1970	r 109	r 76	92	99
1971	r 117	r 90	90	99
1972	r 121	r 104	93	109
1973	r 116	r 101	90	105
1974 p	136	94	57	NA

p Preliminary. r Revised. NA Not available.

[1] Index of labor costs per unit of output: Iron ore and copper indexes are computed from data found in U.S. Department of Labor, Employment and Earnings and Wholesale Price Indexes. Bituminous coal index based upon net tons per man per day (see chapter on Bituminous Coal), and index of average earnings derived from Bureau of Labor Statistics data on hourly earnings; petroleum index based on barrels per year (see chapter on Petroleum), and Bureau of Employment Security data on total wages in petroleum production.

Index of value of product per man-period: Iron ore and copper indexes are computed from data found in U.S. Department of Labor, Employment and Earnings and Wholesale Price Indexes. Bituminous coal index based on net tons per man per day and mine value of production; petroleum index based on average employment and total value of production.

Index of labor costs per dollar of product: Iron ore and copper indexes are computed from data found in U.S. Department of Labor, Employment and Earnings and Wholesale Price Indexes. Bituminous coal index based on index of value per man per day and index of average earnings; petroleum index based on total value of production and total wages.

[2] Indexes are recoverable metal.

[3] Revisions are due to methodology change.

Table 37.—Price indexes for selected cost items in minerals and mineral fuels production

(1967=100)

Commodity	1974		Change from January (percent)	Annual average		Change from 1973 (percent)
	January	December		1973	1974	
Coal	249.3	428.4	+71.8	218.1	332.4	+52.4
Coke	174.1	312.3	+79.4	166.6	247.7	+48.7
Gas fuels	137.1	177.2	+29.2	126.7	162.2	+28.0
Petroleum products, refined	166.4	238.5	+43.3	128.7	223.4	+73.6
Industrial chemicals	108.1	190.1	+75.9	103.4	151.7	+46.7
Lumber	213.3	177.2	−16.9	205.2	207.1	+.9
Explosives	135.2	161.7	+19.6	120.1	146.6	+22.1
Construction machinery and equipment	135.6	170.0	+25.4	130.7	152.3	+16.5

Source: U.S. Department of Labor. Bureau of Labor Statistics. Wholesale Prices and Price Indexes. Supplement 1973 and 1974, December 1974, table 4; January and February 1975, table 11.

Table 38.—Price indexes for mining construction and material handling machinery and equipment

Year	Construction machinery and equipment	Mining machinery and equipment	Oil-field machinery and tools	Power cranes, draglines, shovels, etc.	Specialized construction machinery	Portable air compressors	Scrapers and graders	Mixers, pavers, spreaders, etc.	Tractors other than farm
1970	115.5	110.5	118.4	114.0	117.4	93.7	115.2	116.0	116.7
1971	121.4	113.8	122.6	120.6	125.1	93.8	120.6	122.9	122.3
1972	125.7	117.2	127.3	126.0	129.0	92.0	124.4	126.3	127.3
1973	130.7	121.1	133.2	130.5	134.1	93.5	136.1	130.4	131.5
1974	152.3	143.6	157.8	152.2	151.3	102.8	160.4	145.1	154.7

Source: U.S. Department of Labor, Bureau of Labor Statistics. Wholesale Prices and Price Indexes. Supplement 1971, 1972, 1973, 1974, January–December 1974, April 1975.

Table 39.—National income originated in the mineral industries

Industry	Income, million dollars			Change from 1973 (percent)
	1972	1973 p	1974	
Mining	8,253	9,397	NA	NA
Metal mining	983	1,210	NA	NA
Coal mining	2,233	2,411	NA	NA
Crude petroleum and natural gas	3,508	4,006	NA	NA
Mining and quarrying of nonmetallic minerals	1,529	1,770	NA	NA
Manufacturing	253,352	287,237	NA	NA
Chemicals and allied products	18,503	21,032	NA	NA
Petroleum refining and related industries	8,196	9,364	NA	NA
Stone, clay, and glass products	8,629	9,867	NA	NA
Primary metal industries	18,453	22,025	NA	NA
All industries	946,534	1,065,590	NA	NA

p Preliminary. NA Not available.

Source: U.S. Department of Commerce, Bureau of Economic Analysis. Survey of Current Business. V. 54, No. 7, July 1974, p. 17, table 1.12.

Table 40.—Annual average profit rates on shareholders' equity, after taxes, and total dividends, selected mineral manufacturing corporations

Industry	Annual profit rate (percent)			Total dividends (million dollars)		
	1973	1974 [1]	Change from 1973 (percent)	1973	1974 [1]	Change from 1973 (percent)
All manufacturing	12.8	14.9	+16.4	17,767	19,456	+9.5
Primary metals	10.1	16.4	+62.4	1,101	1,216	+10.4
Primary iron and steel	9.5	16.8	+76.8	559	734	+31.3
Primary nonferrous metals	10.8	15.8	+46.3	543	483	−11.0
Stone, clay, and glass products	11.2	10.6	−5.3	447	450	+.7
Chemicals and allied products	14.8	18.3	+23.6	2,354	2,800	+18.9
Petroleum and coal products	11.6	21.0	+81.0	3,452	4,070	+17.9

[1] Numbers reflect a change in accounting methods from previous years; for further information, see source.

Source: Federal Trade Commission. Quarterly Financial Report for Manufacturing Corporations. 4th Quarter, 1973, tables 4 and 8. Federal Trade Commission. Quarterly Financial Report for Manufacturing, Mining, and Trade Corporations, 4th Quarter, 1974, tables 4, A–D.

Table 41.—Industrial and commercial failures and liabilities in mining and manufacturing

Industry	1972	1973	1974
Mining:[1]			
Number of failures	44	32	9
Current liabilities thousands	$11,907	$23,866	$10,102
Manufacturing:			
Number of failures	1,582	1,481	1,548
Current liabilities thousands	$755,084	$733,624	$828,722
All industrial and commercial industries:			
Number of failures	9,566	9,345	9,915
Current liabilities thousands	$2,000,244	$2,298,606	$3,053,137

[1] Including fuels.

Source: Dun and Bradstreet, Inc., Business Economics Department. Monthly Failure Report. K-15, No. 12, Feb. 14, 1974; Y-16, No. 12, Feb. 18, 1975.

Table 42.—Expenditures for new plant and equipment by firms in mining and selected mineral manufacturing industries

(Billion dollars)

Industry	1972	1973	1974 p
Mining[1]	2.42	2.74	3.18
Manufacturing:			
Primary iron and steel	1.24	1.38	2.12
Primary nonferrous metals	1.18	1.67	2.33
Stone, clay, and glass products	1.20	1.49	1.44
Chemical and allied products	3.45	4.46	5.69
Petroleum	5.25	5.45	8.00
All manufacturing	31.35	38.01	46.01

p Preliminary.
[1] Including fuels.

Source: U.S. Department of Commerce, Bureau of Economic Analysis. Survey of Current Business. V. 54, No. 1, January 1974, p. 11, table 1; v. 55, No. 3, March 1975, p. 17, table 6.

Table 43.—Plant and equipment expenditures of foreign affiliates of U.S. companies by area and industry[1]

(Million dollars)

Area or country	1972			1973			1974		
	Mining and smelting	Petroleum	Manufacturing	Mining and smelting	Petroleum	Manufacturing	Mining and smelting	Petroleum	Manufacturing
Canada	593	835	1,504	514	1,005	1,752	457	1,253	2,122
Latin America	147	681	840	194	695	1,035	286	939	1,234
Europe	6	1,344	4,082	11	1,547	5,131	11	2,179	6,316
All other areas	421	2,300	708	301	3,390	997	498	4,214	1,303
Total	1,167	5,160	7,134	1,020	6,637	8,915	1,252	8,585	10,975

[1] Series revised back to 1966; see source for details.

Source: U.S. Department of Commerce, Bureau of Economic Analysis. Survey of Current Business. V. 53, No. 12, September 1974, pp. 31–33.

Table 44.—Estimated gross proceeds from primary security offerings in 1974[1]

Type of security	Total corporate		Manufacturing		Extractive[2]	
	Million dollars	Percent	Million dollars	Percent	Million dollars	Percent
Bonds	31,567	83.3	9,881	94.8	258	26.3
Preferred stock	2,254	6.0	115	1.1	--	--
Common stock	4,050	10.7	430	4.1	723	73.7
Total	37,871	100.0	10,426	100.0	[3]980	100.0

[1] Substantially all new issues of securities offered for cash sale in the United States in amounts over $100,000 and with terms of maturity of more than 1 year are covered in these data.

[2] Including fuels.

[3] Data do not add to total shown because of independent rounding.

Source: U.S. Securities and Exchange Commission. Statistical Bulletin. V. 34, No. 4, April 1975, pp. 312, 315–318.

Table 45.—Direct private investment of U.S. companies in foreign petroleum industries in 1973 p

(Million dollars; net inflows to the United States designated by—)

	Petroleum				All industries			
	Book value beginning of year	Net capital outflows	Undistributed earnings of subsidiaries	Book value end of year	Book value beginning of year	Net capital outflows	Undistributed earnings of subsidiaries	Book value end of year
Developed countries[1]	14,152	1,053	1,166	16,397	64,359	3,631	6,147	74,084
Canada	5,301	89	476	5,864	25,771	540	1,846	28,055
Europe	6,851	1,016	491	8,387	30,817	2,939	3,476	37,218
Japan	901	—75	96	922	2,375	36	311	2,733
Australia, New Zealand, and South Africa, Republic of	1,100	28	103	1,224	5,395	116	514	6,079
Developing countries[1]	9,774	247	467	10,431	25,235	1,198	1,510	27,867
Latin American Republics and other Western Hemisphere	4,292	—59	208	4,398	16,798	673	1,028	18,452
Other Africa	2,254	—391	145	2,002	3,091	—427	177	2,830
Middle East	1,767	513	99	2,377	1,992	588	108	2,682
Other Asia and Pacific	1,461	184	15	1,659	3,354	365	198	3,903
International, unallocated	2,336	117	294	2,740	4,743	43	467	5,317
Total[1]	26,268	1,417	1,927	29,567	94,337	4,872	8,124	107,268

p Preliminary.

[1] Data may not add to totals shown because of independent rounding.

Source: U.S. Department of Commerce, Bureau of Economic Analysis. Survey of Current Business. V. 54, No. 8, part II, August 1974, pp. 18–21.

Table 46.—Direct private investments of the United States in foreign mining and smelting industries in 1973 [p]

(Million dollars)

	Book value at yearend	Net capital outflows	Undistributed earnings of subsidiaries	Earnings [1]	Income [2]
Developed countries [3]	4,774	232	116	369	261
Canada	3,735	190	91	230	149
Europe	87	14	(4)	(4)	(4)
Australia, New Zealand, Republic of South Africa	951	29	25	136	109
Australia	785	16	16	100	83
South Africa, Republic of	158	13	8	36	26
Developing countries [3]	2,709	−32	28	306	287
Latin American Republics, total [3]	1,342	28	15	156	146
Mexico	128	−3	8	14	6
Panama	19	(5)	(5)	(4)	--
Brazil	180	(4)	(4)	(4)	(4)
Chile	359	(5)	(5)	(4)	(4)
Peru	439	22	1	89	89
Other Western Hemisphere	765	−16	(4)	95	98
Other Africa	397	−48	15	33	19
Middle East	5	(5)	--	(4)	(4)
Other Asia and Pacific	199	5	−2	21	24
Total [3]	7,483	201	143	675	548

[p] Preliminary.
[1] Earnings is the sum of the U.S. share in net earnings of subsidiaries and branch profits.
[2] Income is the sum of dividends, interest, and branch profits.
[3] Data may not add to totals shown because of independent rounding.
[4] Combined in "other industries" in source reference.
[5] Less than ½ unit.

Source: U.S. Department of Commerce, Bureau of Economic Analysis. Survey of Current Business. V. 54, No. 8, Part II, August 1974, p. 18.

Table 47.—Value of foreign direct investments in the United States

(Million dollars)

Industry	1969	1970	1971	1972	1973 [p]
Total	11,818	13,270	13,655	14,268	17,748
Petroleum	2,493	2,992	3,118	3,284	4,425

[p] Preliminary.

Source: U.S. Department of Commerce, Bureau of Economic Anaylsis. Survey of Current Business. V. 53, No. 2, February 1973, p. 30; v. 54, No. 8, Part II, August 1974, p. 7.

Table 48.—Railroad and water transportation of selected minerals and mineral energy products in the United States

(Thousand short tons)

Products	Rail [1]			Water [2]		
	1972 [3]	1973	Change from 1972 (percent)	1972	1973	Change from 1972 (percent)
Metals and minerals except fuels:						
Iron ore and concentrates	90,150	102,442	+13.6	73,458	83,979	+14.3
Iron and steel scrap	28,488	33,472	+17.5	1,729	1,826	+5.6
Pig iron	3,489	4,280	+22.7	339	281	−17.1
Iron and steel ingot, plates, rods, bars, tubing, and other primary products	35,712	52,605	+47.3	8,881	9,183	+3.4
Bauxite and other aluminum ores and concentrates	4,604	5,825	+26.5	75	313	+317.3
Other nonferrous ores and concentrates	14,286	15,654	+9.6	1,517	1,441	−5.0

See footnotes at end of table.

Table 48.—Railroad and water transportation of selected mineral and mineral energy products in the United States—Continued

(Thousand short tons)

Products	Rail[1]			Water[2]		
	1972[3]	1973	Change from 1972 (percent)	1972	1973	Change from 1972 (percent)
Metals and minerals except fuels—Continued:						
Nonferrous metals and alloys	9,614	10,611	+10.4	632	652	+3.2
Nonferrous metal scrap	1,474	2,979	+102.1	64	72	+12.5
Slag	2,082	2,097	+.7	1,165	937	−19.6
Sand and gravel	52,521	51,004	−2.9	80,356	81,774	+1.8
Stone, crushed and broken	58,031	59,757	+3.0			
Limestone flux and calcareous stone	9,889	11,200	+13.3	31,613	36,497	+15.4
Cement, building	21,387	20,835	−2.6	10,634	9,739	−8.4
Lime	6,600	6,610	+.2	992	614	−38.1
Phosphate rock	36,442	39,146	+7.4	8,762	8,888	+1.4
Clays, ceramic and refractory materials	3,257	3,329	+2.2	1,489	1,571	+5.6
Sulfur, dry	3,894	4,635	+19.0	59	42	−28.8
Sulfur, liquid				9,028	8,821	−2.3
Gypsum and plaster rock	704	2,230	+216.8	963	1,102	+14.4
Other nonmetallic minerals except fuels	3,674	3,681	+.2	7,075	6,271	−11.4
Fertilizer and fertilizer materials	19,284	19,529	+1.3	6,943	5,950	−14.3
Total	405,582	451,921	+11.4	245,769	259,953	+5.8
Mineral energy resources and related products:						
Coal:						
Anthracite	3,335	3,358	+.6	148,994	144,522	−3.0
Bituminous and lignite	371,135	372,220	+.3			
Coke	18,778	21,857	+16.4	1,186	1,847	+55.7
Crude petroleum	1,028	1,722	+67.5	103,673	90,519	−12.7
Gasoline	1,502	1,340	−10.8	93,615	94,069	+.5
Jet fuel				13,173	12,715	−3.5
Kerosine	105	96	−8.6	6,089	5,428	−10.9
Distillate fuel oil	1,128	1,306	+15.8	85,328	84,636	−.8
Residual fuel oil	5,908	7,031	+19.0	102,209	108,898	+6.5
Asphalt, tar, and pitches	2,985	3,146	+5.4	9,176	9,206	+.3
Liquefied petroleum gases and coal gases	7,001	7,212	+3.0	1,537	1,550	+.8
Other petroleum and coal products[4]	20,950	24,006	+14.6	11,805	14,189	+20.2
Total	434,355	443,794	+2.2	576,785	567,574	−1.6
Total mineral products	839,937	895,715	+6.6	822,554	827,527	+.6
Grand total, all commodities	1,447,864	1,532,165	+5.8	986,812	994,158	+.7
Mineral products, percent of grand total:						
Metals and minerals except fuels	28.0	29.5	+5.4	24.9	26.1	+4.8
Mineral energy resources and related products	30.0	29.0	−3.3	58.4	57.1	−2.2
Total mineral products[5]	58.0	58.5	+.9	83.4	83.2	−.2

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[1] Revenue freight originated on respondent's road and terminated on line by originating carrier or delivered to connecting rail carrier.

[2] Domestic traffic includes all commercial movements between points in the U.S., Puerto Rico, and Virgin Islands.

[3] Erroneously reported in 1972.

[4] Includes lubricants, naphtha, and other petroleum solvents, and miscellaneous and petroleum products.

[5] **Data may not add to totals shown because of independent rounding.**

Source: Interstate Commerce Commission, Bureau of Accounts. Freight Commodity Statistics. Class I Railroads in the United States, Dec. 31, 1972 and 1973. Department of the Army, Corps of Engineers, Waterborne Commerce of the United States, Part 5. National Summaries, Calendar years 1972 and 1973, table 2.

Table 49.—Percentage distribution of mine shipments of bituminous coal and lignite by method of shipment and mine use

Year	Shipped by rail and trucked to rail	Shipped by water and trucked to water	Trucked to final destination	Used at mines [1]	Total production
1970	68.1	13.5	12.0	6.4	100.0
1971	69.2	10.7	10.9	9.2	100.0
1972	66.2	11.7	11.0	11.1	100.0
1973	67.1	11.5	9.8	11.6	100.0
1974	[2] 77.1	([2])	11.0	11.9	100.0

[1] Includes coal used at mine for power and heat, made into beehive coke at mine, used by mine employees, used for all other purposes at mine, and transported from mine to point of use by conveyor, tram, or pipeline.

[2] Bituminous coal and lignite shipped by water included with that shipped by rail.

Table 50.—Miles of utility gas main, by type of main [1]

(Thousands)

Type of main	1969	1970	1971	1972	1973
Field and gathering	64.9	66.6	66.5	67.1	68.2
Transmission	248.1	252.6	256.5	260.2	265.2
Distribution	578.6	595.6	610.7	r 624.6	634.3
Total	891.6	914.8	r 933.7	r 951.9	967.7

r Revised.

[1] Excludes service pipe. Data not adjusted to common diameter equivalent. Mileage shown as of end of each year.

Source: American Gas Association. Gas Facts, a Statistical Record of the Gas Utility Industry in 1973, p. 50.

Table 51.—Petroleum pipelines, selected years

(Miles)

Year	Trunklines: Crude	Trunklines: Products	Gathering lines	Total
1962	70,355	53,200	76,988	200,543
1965	72,383	61,443	77,041	210,867
1968	70,825	64,529	74,124	209,478
1971 r	75,143	72,396	71,132	218,671
1974	76,250	76,839	69,266	222,355

r Revised.

Table 52.—Research and development activity

(Million dollars)

	Total			Funds expended: Company			Funds expended: Federal Government		
	1971	1972	1973	1971	1972	1973	1971	1972	1973
Petroleum refining and extraction	505	473	504	488	458	490	17	15	14
Percent of all industries	2.8	2.4	2.4	4.6	4.0	3.9	0.2	0.2	0.2
Chemicals and allied products	1,819	1,909	2,079	1,635	1,713	1,871	184	196	208
Percent of all industries	9.9	9.8	9.9	15.4	15.1	14.8	2.4	2.4	2.5
All industries	18,311	19,437	20,937	10,645	11,347	12,680	7,666	8,090	8,257

Source: National Science Foundation. Research and Development in Industry. NSF 74–312, July 1974, table B–2. National Science Foundation. Science Resources Studies Highlights. NSF 74–319, Dec. 4, 1974, p. 2.

Table 53.—Federal obligated funds for metallurgy and materials research

(Thousand dollars)

Federal agency	Fiscal year 1974 •			Fiscal year 1975 •		
	Basic research	Applied research	Total research	Basic research	Applied research	Total research
Department of Defense	33,950	72,979	106,929	38,084	77,209	115,293
Atomic Energy Commission	12,907	11,900	24,807	17,550	12,300	29,850
National Aeronautic and Space Administration	7,732	47,647	55,379	7,140	56,075	63,215
Bureau of Mines	962	18,738	19,700	843	30,942	31,785
National Science Foundation	10,148	840	10,988	13,330	1,120	14,450
Department of Commerce	725	1,569	2,294	747	1,731	2,478
Federal Highway Administration	--	76	76	--	113	113
Other	5	2,138	2,143	5	1,853	1,858
Total	66,429	155,887	222,316	77,699	181,343	259,042

• Estimate.

Source: National Science Foundation. Federal Funds for Research Development, and Other Scientific Activities, Fiscal Years 1973, 1974, and 1975, v. XXIII. Detailed Statistical Tables, Appendices C and D. NSF 74–320–A, September 1974, tables C–24, C–25, C–43, C–44, C–62, C–63.

Table 54.—Bureau of Mines obligations for mining and mineral research and development

(Thousand dollars)

Fiscal year	Applied research	Basic research	Development	Total
1971	32,214	6,525	21,561	60,300
1972	32,805	7,846	30,237	70,888
1973	34,591	6,863	36,053	77,507
1974	24,880	5,637	35,590	66,107
1975 •	51,609	2,010	62,537	116,156

• Estimate.

Table 55.—Bureau of Mines obligations for total research, by field of science

(Thousand dollars)

	Fiscal year		
	1973	1974	1975 •
Engineering sciences	30,490	23,909	45,804
Physical sciences	9,263	5,294	2,039
Mathematical sciences	555	477	2,270
Environmental sciences	1,146	837	3,506
Total	41,454	30,517	53,619

• Estimate.

Table 56.—Summary of Government inventories of strategic and critical materials December 31, 1974

	Acquisition cost	Market value [1]
Total inventories in storage:		
National stockpile	$2,660,690,200	$5,741,697,000
Supplemental stockpile	1,129,556,800	2,080,416,200
Defense Production Act	346,133,800	214,899,700
Total on hand	4,136,380,800	8,037,012,900
Inventories within objective (in storage):		
Total on hand	528,342,700	1,189,629,000
Excess inventories in storage:		
Total on hand	3,608,038,100	6,847,383,900

[1] Market values are computed from prices at which similar materials are being traded; or in the absence of current trading, at an estimate of the price that would prevail in commercial markets. Prices used are unadjusted for normal premiums and discounts relating to contained qualities, or for inherent materials-handling allowances. Market values do not necessarily reflect the amount that would be realized at time of sale. The uncommitted excess excludes the unshipped sales; the inventories in storage include quantities that have been sold but not shipped.

Source: General Services Administration, Office of Preparedness. Stockpile Report to the Congress. July–December 1974, p. 2.

Table 57.—U.S. Government stockpile disposal of mineral commodities, 1974

Commodity		Sales commitments	
		Quantity	Sales values
NATIONAL AND SUPPLEMENTAL STOCKPILE INVENTORIES			
Aluminum	short tons	283,698	$176,785,549
Aluminum oxide, fused, crude	do	45,288	5,949,885
Antimony	do	4	7,800
Asbestos, amosite	do	11,408	2,414,945
Asbestos, chrysotile	do	120	25,800
Asbestos, crocidolite	do	11,898	2,628,565
Cadmium	pounds	2,001,578	7,851,025
Chromite, chemical	short dry tons	322,886	6,308,822
Chromite, refractory	do	571,163	14,219,932
Chromium metal	short tons	3,182	8,356,520
Cobalt	pounds	9,325,667	29,759,641
Columbium ores and concentrates	do	1,893,287	4,248,061
Copper	short tons	251,106	449,710,620
Diamond, industrial, bort	carats	2,921,500	6,530,227
Diamond, industrial, stones	do	1,502,451	14,775,771
Lead	short tons	229,294	95,439,364
Magnesium	do	20,981	17,012,029
Manganese, battery-grade, synthetic dioxide	short dry tons	9,808	3,712,251
Manganese, chemical	do	1,000	64,500
Manganese, metallurgical	do	128,079	4,081,424
Manganese, ferro, high-carbon	short tons	233,968	49,968,677
Mica, muscovite, block	pounds	2,663,376	1,084,502
Mica, muscovite, film	do	123,110	29,356
Mica, muscovite splittings	do	5,427,435	744,681
Mica, phlogopite block	do	5,434	7,267
Mica, phlogopite splittings	do	317,802	216,685
Molybdenum disulfide	do	22,618,198	36,946,926
Molybdenum, ferro	do	4,683,914	10,198,371
Molybdic oxide	do	8,559,678	16,695,880
Platinum, iridium	troy ounces	170	70,168
Quartz crystals	pounds	749,941	2,368,825
Rare earths	short dry tons	838	517,780
Selenium	pounds	126,442	3,034,410
Silicon carbide, crude	short tons	77,354	22,144,247
Talc, steatite, block	do	20	4,000
Thorium nitrate	pounds	303,246	560,312
Tin	long tons	23,554	196,942,599
Tungsten, ferro	pounds	115,421	674,107
Tungsten metal power, hydrogen-reduced	do	294,240	1,410,440
Tungsten ores and concentrates	do	5,918,359	28,104,539
Zinc	short tons	266,758	180,718,956
Total		--	1,402,270,459
DEFENSE PRODUCTION ACT (DPA) INVENTORY			
Aluminum	short tons	169,852	100,825,153
Chromite, metallurgical	short dry tons	899,949	6,146,974
Columbium ores and concentrates	pounds	268,939	730,799
Manganese, battery-grade, synthetic dioxide	short dry tons	875	394,000
Manganese, metallurgical	do	370,106	7,434,399
Mica, muscovite block	pounds	3,310,590	1,853,629
Mica, muscovite film	do	87,212	309,065
Rutile	short dry tons	3,692	1,063,296
Tantalum minerals	pounds	403,164	6,247,331
Titanium	short tons	4,910	11,111,168
Tungsten ores and concentrates	pounds	152,778	423,812
Total		--	136,539,626
OTHER			
Bauxite, metallurgical	long dry tons	671,000	3,000,000
Lithium	pounds	5,162,000	2,455,885
Mercury	flasks	2,353	687,315
Total		--	6,143,200
Grand total		--	1,544,953,285

Source: General Services Administration, Office of Preparedness. Stockpile Report to the Congress. January–June 1974, pp. 14–15; July–December 1974, pp. 12–13.

Table 58.—United Nations indexes of world[1] mineral industry production

(1970=100)

Industry sector and geographic area	1972	1973	1974	1974 by quarters 1st	2nd	3d	4th
EXTRACTIVE INDUSTRIES							
Metals:							
Market economy countries	99	103	105	103	106	104	107
Developed[2]	95	100	99	96	101	98	101
United States and Canada	93	102	100	95	106	98	103
Europe	85	88	76	73	79	72	83
European Economic Communities[3]	93	90	85	93	86	73	88
European Free Trade Association[4]	107	117	124	127	128	109	130
Australia and New Zealand	101	97	97	90	90	111	99
Developing[5]	104	108	114	113	115	113	116
Latin America[6]	104	108	118	118	117	117	120
Asia[7]	98	96	93	92	95	93	93
Centrally planned economy countries (Europe)[8]	114	122	126	128	126	126	123
World	102	108	110	108	111	109	111
Coal:							
Market economy countries	111	121	126	124	128	125	126
Developed[2]	89	87	82	81	85	80	84
United States and Canada	101	101	102	107	108	102	89
Europe	85	88	76	73	79	72	83
European Economic Communities[3]	83	81	74	70	76	69	80
European Free Trade Association[4]	101	96	97	103	96	89	93
Australia and New Zealand	115	116	122	103	124	136	124
Developing[5]	105	107	113	113	108	115	118
Latin America[6]	108	109	121	NA	NA	NA	NA
Asia[7]	87	81	81	81	79	81	83
Centrally planned economy countries (Europe)[8]	105	107	108	111	108	106	111
World	97	96	96	95	96	93	93
Crude petroleum and natural gas:							
Market economy countries	111	121	126	124	128	125	126
Developed[2]	110	112	112	116	111	107	114
United States and Canada	104	104	103	105	108	101	101
Europe	141	160	167	186	152	138	193
European Economic Communities[3]	147	166	176	197	159	143	206
European Free Trade Association[4]	NA	NA	NA	NA	NA	NA	NA
Australia and New Zealand	--	--	--	--	--	--	--
Developing[5]	112	127	136	129	140	138	135
Latin America[6]	96	102	99	101	97	98	98
Asia[7]	127	149	168	152	170	165	167
Centrally planned economy countries (Europe)[8]	114	122	131	134	134	129	128
World	112	121	127	126	129	126	127
Total extractive industry:							
Market economy countries	105	112	115	118	117	114	117
Developed[2]	109	119	120	120	122	117	119
United States and Canada	101	104	103	104	105	102	102
Europe	97	100	99	99	100	92	105
European Economic Communities[3]	106	114	116	97	97	89	103
European Free Trade Association[4]	104	111	115	103	96	89	98
Australia and New Zealand	131	138	140	132	135	143	148
Developing[5]	115	126	137	128	136	139	144
Latin America[6]	99	105	107	107	104	108	110
Asia[7]	122	140	152	143	157	158	154
Centrally planned economy countries (Europe)[8]	113	120	125	128	126	123	128
World	107	114	118	117	120	117	119
PROCESSING INDUSTRIES							
Base metals:							
Market economy countries	105	118	119	122	128	116	117
Developed[2]	104	117	118	121	121	113	115
United States and Canada	105	117	116	121	128	110	109
Europe	102	112	116	119	118	110	118
European Economic Communities[3]	99	109	112	116	113	106	113
European Free Trade Association[4]	105	110	113	117	118	102	115
Australia and New Zealand	101	107	108	110	94	109	119

See footnotes at end of table.

Table 58.—United Nations indexes of world[1] mineral industry production—Continued

(1970=100)

Industry sector and geographic area	1972	1973	1974	1974 by quarters: 1st	2nd	3d	4th
PROCESSING INDUSTRIES—Continued							
Base metals—Continued:							
Market economy countries—Continued:							
Developing[5]	119	127	140	NA	NA	NA	NA
Latin America[6]	125	135	150	141	156	155	150
Asia[7]	127	129	134	129	129	127	121
Centrally planned economy countries (Europe)[8]	112	120	127	129	127	126	125
World	107	119	122	124	124	119	119
Nonmetallic mineral products:							
Market economy countries	117	126	135	135	138	131	136
Developed[2]	111	121	119	116	124	119	116
United States and Canada	112	123	119	115	125	124	113
Europe	111	119	119	114	125	117	119
European Economic Communities[3]	110	116	115	111	122	112	114
European Free Trade Association[4]	110	118	119	116	128	114	115
Australia and New Zealand	111	119	118	112	124	123	114
Developing[5]	118	130	141	130	142	147	144
Latin America[6]	112	123	119	115	125	124	113
Asia[7]	128	127	130	124	125	123	117
Centrally planned economy countries (Europe)[8]	117	126	135	135	138	131	136
World	114	124	127	124	131	126	126
Chemicals, petroleum, and coal products:							
Market economy countries	120	134	147	146	148	146	146
Developed[2]	115	127	130	131	134	129	126
United States and Canada	116	126	128	127	132	131	124
Europe	113	126	132	135	138	126	129
European Economic Communities[3]	112	125	130	134	136	123	125
European Free Trade Association[4]	112	120	125	129	130	118	123
Australia and New Zealand	114	127	134	122	137	140	134
Developing[5]	117	127	136	124	130	135	153
Latin America[6]	127	132	131	124	NA	NA	NA
Asia[7]	128	125	144	126	121	122	137
Centrally planned economy countries (Europe)[8]	120	134	147	146	148	146	146
World	116	129	134	134	137	133	133
OVERALL INDUSTRIAL PRODUCTION							
Market economy countries	109	120	122	121	124	120	122
Developed[2]	109	119	120	120	122	117	119
United States and Canada	109	119	119	119	121	120	116
Europe	108	116	119	120	122	110	123
European Economic Communities[3]	106	114	116	117	118	108	120
European Free Trade Association[4]	107	114	117	118	121	108	123
Australia and New Zealand	110	118	122	117	123	127	121
Developing[5]	115	126	137	128	136	139	144
Latin America[6]	116	126	137	NA	NA	NA	NA
Asia[7]	112	129	131	131	132	131	132
Centrally planned economy countries (Europe)[8]	118	129	140	140	143	138	139
World	112	122	127	126	129	125	127

NA Not available.

[1] Excludes Albania, the People's Republic of China, Mongolia, North Korea, and North Vietnam.

[2] Canada, the United States, all countries of Europe except those listed in footnotes 1 and 8, the Republic of South Africa, Israel, Japan, Australia and New Zealand.

[3] Belgium, Denmark, France, West Germany, Ireland, Italy, Luxembourg, the Netherlands, and the United Kingdom.

[4] Austria, Norway, Portugal, Sweden, and Switzerland.

[5] Countries not indicated in footnotes 1, 2, and 8.

[6] Corresponds to the United Nations classifications "Caribbean, Central and South America."

[7] Corresponds to the United Nations classifications "Asia, excluding Israel and Japan."

[8] Bulgaria, Czechoslovakia, East Germany, Hungary, Poland, Romania, and the U.S.S.R.

[9] Reported as zero in source, but both Australia and New Zealand produce natural gas; insufficient data available to calculate index number.

Source: United Nations. Monthly Bulletin of Statistics. August 1975, pp. xii–xxv.

Table 59.—Comparisons of world and U.S. production and U.S. imports of principal minerals and mineral fuels in 1974

Mineral	World production (thousand short tons unless otherwise stated) p	U.S. production (percent of world production)	U.S. imports (percent of world production)	Total 1974 U.S. production and imports (percent of world production)	Total 1973 U.S. production and imports (percent of world production)
METALLIC ORES AND CONCENTRATES					
Bauxite ---- thousand long tons --	76,989	2.5	18.6	21.1	21.8
Chromite ----------	7,931	--	13.9	13.9	12.6
Copper (content of ore and concentrate) ----------	8,105	19.7	3.3	23.2	23.8
Iron ore ---- thousand long tons --	879,414	9.6	5.5	15.1	15.7
Lead (content of ore and concentrate) ----------	3,845	17.3	1.6	18.9	18.0
Mercury-thousand 76-pound flasks -	262	.8	19.9	20.7	18.0
Molybdenum (content of ore and concentrate) thousand pounds --	188,274	59.5	(1)	59.6	63.2
Nickel (content of ore and concentrate) ----------	826	2.0	26.7	28.7	27.6
Platinum-group (Pt, Pd, etc.) thousand troy ounces --	5,760	(1)	56.3	56.5	48.2
Silver ---------- do ----	295,562	11.4	45.1	56.6	54.5
Titanium concentrates:					
Ilmenite [2] ----------	3,148	23.6	2.6	26.3	28.4
Rutile [2] ----------	369	1.7	63.8	65.5	58.2
Tungsten concentrate (60% tungsten dioxide) thousand pounds --	82,357	9.0	13.5	22.4	21.9
Zinc (content of ore and concentrate) ----------	6,384	7.8	2.1	9.9	10.1
METALS, SMELTER BASIS					
Aluminum ----------	14,517	33.8	4.3	38.1	38.4
Copper ----------	8,148	19.3	3.8	23.1	24.6
Iron, pig ----------	566,534	16.9	(1)	16.9	18.4
Lead ----------	3,821	17.9	3.2	21.1	22.9
Magnesium ----------	W	W	W	W	47.2
Steel ingots and castings ----------	779,849	18.7	2.1	20.8	21.7
Tin ---- thousand long tons --	226	2.7	17.6	20.2	22.2
Uranium oxide [2] ---- short tons --	24,176	47.7	7.6	55.3	73.5
Zinc ----------	5,968	9.3	9.1	18.4	20.1
NONMETALS					
Asbestos ----------	4,536	2.5	16.9	19.4	20.9
Cement ----------	776,210	10.7	.7	11.4	12.2
Diamond ---- thousand carats --	44,085	--	52.1	52.1	54.9
Feldspar ----------	3,174	26.9	(1)	26.9	26.5
Fluorspar (marketable) ----------	5,082	4.0	26.3	30.2	29.0
Gypsum ----------	66,109	18.2	11.2	29.4	31.3
Mica (including scrap) thousand pounds	520,946	52.6	1.4	54.0	57.3
Nitrogen, agricultural [3] ----------	45,037	22.4	2.6	25.0	24.5
Phosphate rock ----------	121,601	37.6	(1)	37.7	38.8
Potash (K_2O equivalent) ----------	26,068	9.8	16.6	26.4	25.5
Salt ----------	172,228	27.0	1.9	28.9	28.3
Sulfur, all forms thousand long tons -	50,861	22.5	[4]4.2	[4]26.7	[4]25.1
MINERAL ENERGY RESOURCES					
Crude petroleum thousand barrels --	20,516,240	15.6	6.2	21.8	22.3
Natural gas -- million cubic feet --	47,137,672	45.8	2.0	47.9	51.3
Bituminous coal and lignite ----------	3,243,556	18.6	(1)	18.7	18.4
Anthracite ----------	206,258	3.2	--	3.2	3.5

p Preliminary. W Withheld to avoid disclosing individual company confidential data.

[1] Less than ½ unit.

[2] World total exclusive of the U.S.S.R.

[3] Year ended June 30, 1974.

[4] Does not provide for sulfur content of imported compounds.

Table 60.—Value of world export trade in major mineral commodity groups[1]
(Million U.S. dollars)

Commodity group	1969 r	1970 r	1971 r	1972 r	1973
Metals:					
All ores, concentrates, scrap	6,360	8,110	7,120	7,730	11,220
Iron and steel	13,710	17,070	17,760	20,080	28,510
Nonferrous metals	11,180	12,200	10,410	11,700	16,940
Subtotal	31,250	37,380	35,290	39,510	56,670
Nonmetals (crude only)	2,270	2,380	2,820	3,190	4,160
Mineral fuels	24,480	28,290	36,520	44,060	63,100
Total	58,000	68,050	74,630	86,760	123,930
All commodities	271,910	311,990	348,980	415,330	572,650

r Revised.

[1] Data presented are for selected major commodity groups of the Standard International Trade Classification—Revised (SITC—R), and as such exclude some mineral commodities classified in that data array together with other (nonmineral) commodities. SITC—R categories included are as follows: Ores, concentrates, and scrap—SITC Division 28; iron and steel—SITC Division 67; nonferrous metals—SITC Division 68; nonmetals (crude only)—SITC Division 27; mineral fuels—SITC Division 3. Major items not included are the metals, metalloids, and metal oxides of SITC Group 513; mineral tar and crude chemicals from coal, petroleum, and natural gas of SITC Division 52; manufactured fertilizers of SITC Division 56; and nonmetallic mineral manufactures of SITC Groups 661, 662, 663, and 667.

Source: United Nations. Monthly Bulletin of Statistics. V. 29, No. 7, July 1975, pp. xxiv–xli.

Table 61.—Mineral commodity export price indexes
(1963=100)

Year and quarter	Metal ores	Fuels	All crude minerals
1972	134	143	141
1973	161	188	181
1974:			
First quarter	213	537	462
Second quarter	231	548	476
Third quarter	212	561	483
Fourth quarter	207	565	486
Annual average	216	553	477

Source: United Nations. Monthly Bulletin of Statistics. New York, September 1975, p. xv.

Table 62.—Analysis of export price indexes
(1963=100)

Year and quarter	Developed areas		Developing areas	
	Total minerals	Nonferrous base metals	Total minerals	Nonferrous base metals
1972	154	150	135	161
1973	191	207	173	252
1974:				
First quarter	227	273	536	350
Second quarter	310	308	540	407
Third quarter	337	244	538	285
Fourth quarter	369	221	529	233
Annual average	323	261	536	319

Source: United Nations. Monthly Bulletin of Statistics. New York, September 1975, p. xv.

Mining and Quarrying Trends in the Metal and Nonmetal Industries

By John L. Morning [1]

Although the value of metal and nonmetal mineral output from the Nation's mines increased by 21% during 1974, inflation pushed up mining costs and detracted from the apparent improved industry performance. As the year progressed, the industry was generally faced with declining profit margins resulting from increasing costs, declining revenues, and slackening demand. At yearend, the industry was increasing its reliance on new mining methods and improved technology to strengthen efficiency and production and to retain its profit margins.

Of the several significant technologic trends emerging in the mining industry during the year, one of the most notable was the constantly expanding application of computers in mining- and mineral-related operations from exploration through metallurgical process control. Computer programs were used to integrate data from geologic and mineral maps, accounting records, and price quotations to determine the economic value of various blocks of an ore body. Other uses for computers included reserve calculations, development drilling correlation, short- and long-range engineering planning, equipment use and maintenance scheduling, and spare parts control. In combination with digitizers and cathode-ray tubes (CRT), computers were increasingly used as drafting tools to help assess the impact of various alternatives in mine and pit design. In addition to the growing list of engineering applications, the use of computers continued to grow in the more familiar administrative areas such as accounting and payroll.

The use of remote sensing techniques drew increasing attention during the year in efforts to reduce exploration time and reach less accessible but promising areas of mineralization. Remote sensing is a multistage process in which sensors like the Earth Resources Technology Satellite (ERTS) and Side Looking Airborne Radar (SLAR) may be followed by medium- and large-scale aerial photography, infrared imagery, and airborne geophysical surveys in potentially mineral-rich areas. Data collected by the various processes are analyzed to determine if lithographic and structural features are indicative of possible mineralization.

The growing availability and use of automated large-diameter rotary drills continued as one of the most significant advances in drilling technology. These automated drills sense and respond to changing drill parameters, minimizing human errors and augmenting operator skill. Ultimately, per foot drilling costs are reduced, maintenance is minimized, and machine availability is increased.

In general, trends toward still larger and more automated equipment continued to dominate load and haul operations. The largest off-highway hauler manufactured, a 350-ton-capacity giant, was introduced during the year. Locomotives continued to increase in sophistication; some units were introduced with remote control. An electronic system for piloting driverless trucks was demonstrated and reported to be available commercially. The trend towards

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[1] Supervisory physical scientist, Division of Ferrous Metals.

"bigger is better" was apparently slowing, however, in stripping equipment, and the 100-cubic-yard machine was gaining favor over larger equipment owing to the recurrence of problems with the oversize machinery.

In response to growing safety concerns, the largest manufacturer of nitroglycerin-based dynamite announced that it would remove these dynamites from its product lines by late 1976. A series of water gels employing less sensitive monomethylamine nitrate (MMAN) would be used as a substitute.

The shortage of fuels combined with sharply increased prices forced many companies to reexamine their energy needs and implement conservation and employee awareness programs in efforts to increase efficiency of energy use. The rising fuel and power prices were largely responsible for the introduction of numerous new energy-efficient products.

The Market Research Department of the Engineering and Mining Journal continued to make surveys on equipment in the minerals industry. Studies were published on both the coal and the metal and nonmetallic mining industries. One survey was the basis of three reports.[2] These studies presented information on quantity, size, and make of equipment and on replacement practices, future purchasing plans, and utilization.

Materials Handled.—Producers of metal and nonmetal minerals (excluding fuels) handled nearly 4.6 billion tons of ore and waste in 1974, down 2% from that of 1973 but 12% higher than in 1970 and 42% higher than in 1965. During the past 10 years, total material handled has grown at an annual rate of 3.6%.

Crude ore output in 1974 totaled 2,930 million tons, down 1% from that of 1973. This compares with 2,680 million tons produced in 1970, and 2,400 million tons produced in 1965. Crude ore output has grown at a rate of 2% annually during the last decade.

Quantities of waste mined to permit ore recovery totaled 1,650 million tons in 1974, down 3.5% from that of 1973. In 1965, waste material handled totaled 810 million tons, and in 1970, 1,410 million tons.

Copper and iron ore accounted for 85% of crude metal ore production, whereas phosphate rock, stone, and sand and gravel accounted for 94% of the nonmetal mine crude ore output.

Fourteen States each reported handling more than 100 million tons of total material, the same as in 1973. Arizona was the leader, followed by Florida and Minnesota. Nine States each reported over 100 million tons of crude ore production. Florida was the leader, followed by Minnesota and Arizona.

Eleven States indicated an increase in crude ore production, 17 States registered increased waste material handled, and 11 States indicated an increase in total material handled, compared with 1973 totals.

Magnitude of the Mining Industry.—Crude ore output in 1974 was reported from 14,990 mines and quarries, a 4% increase over the number reporting in 1973. In addition to these mines, 106 wells, ponds, or pumping operations produced sulfur, salt, lithium, boron, and magnesium. Crude ore production from individual mines ranged from about 1 to nearly 43 million tons, and total material handled ranged from about 1 to over 140 million tons.

Twenty-five mines reported over 10 million tons of crude ore production, four more than in 1973. Sand and gravel and phosphate rock mines accounted for the increase; sand and gravel mines increased from none to three, and phosphate rock mines rose from four to six. One copper mine dropped from the listing. In contrast, in 1966, 14 mines each had outputs of 10 million tons of crude ore. In terms of total material handled, 64 mines moved over 10 million tons of material each.

In terms of crude ore output, the 25 leading metal mines produced over 413 million tons of crude ore, a 7.8% decrease compared with that of 1973, and accounted for 66% of the total crude ore from metal mines. In terms of total material handled, the 25 leading metal mines moved 1,248 million tons of crude ore and waste, nearly 9% less than in 1973.

The 25 leading nonmetal mines, in terms of crude ore output, produced 199 million tons of crude ore, 6% more than in 1973, and accounted for nearly 9% of nonmetal crude ore production. The 25 leading nonmetal mines, in terms of total material handled, moved 419 million tons of material, 5% more than in 1973.

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[2] Engineering and Mining Journal. Power Shovels. 1974, 25 pp.

Engineering and Mining Journal. Draglines. 1974, 25 pp.

Engineering and Mining Journal. Backhoes. 1974, 21 pp.

The Minntac mine of United States Steel Corp. continued to be the leader in crude metal ore production, followed by the Utah Copper mine of Kennecott Copper Corp. and the Erie Commercial mine of Pickands Mather & Co. In the top 25 listing, 6 mines reported an increase in crude ore production over that of 1973. The Lakehurst mine of American Smelting and Refining Co., producing ilmenite (titanium), approached operating capacity as output increased dramatically, and the mine made the top 25 listing for the first time.

The Suwannee phosphate rock mine of Occidental Petroleum Corp. returned to the top of the listing of 25 large nonmetallic mines in output of crude ore, a place that it held in 1972. The Calcite mine of United States Steel Corp. dropped to second place, followed by the Kingsford phosphate rock mine of International Minerals & Chemical Corp. In terms of total material handled for nonmetal mines, the leader was the Kingsford, followed by the Noralyn phosphate rock mine of International Minerals & Chemical Corp. and the Suwanne mine.

Large metal mines were located in 11 States with Arizona accounting for 8 mines, while large nonmetal mines were in 8 States with Florida accounting for 14.

Value of Principal Mineral Products.—When possible, the measurement of value used in table 4 is for crude ore treated or, in the case of some nonmetals, crude ore shipped. For some commodities the value is of beneficiated products. Values of some metals are assigned according to average selling price of refined metal.

Paralleling price increases resulting from inflation, the average value for all commodities increased 30% compared with that of 1973, rising from $2.94 per ton to $3.82 per ton. The average value for metals rose from $6.56 per ton in 1973 to $8.74 per ton in 1974, a 33% increase, while the average value for nonmetals increased from $1.96 per ton in 1973 to $2.48 per ton in 1974, a 27% increase. For comparison, the average value in 1966 for all commodities was $2.42 per ton; for metals, $5.14 per ton; and for nonmetals, $1.76 per ton.

The value of byproducts contributed to the overall value of a majority of the mineral commodities listed in table 4. Byproducts were a significant part of total value of metals such as bauxite, 22%; lead, 36%; silver, 14%; and zinc, 16%; and for nonmetals such as feldspar, 9%; and fluorspar, 18%. Except for salt and stone, value of byproducts at underground mines was substantially higher than at surface mines. Byproducts contributed 9% of the total value for metal ores and except for feldspar and fluorspar were insignificant for nonmetal minerals. Excluding the large-volume commodities of sand and gravel and stone, byproducts contributed 7% to the combined value of metal and nonmetal ores.

Comparison of Production From Surface and Underground Mines.—Surface mines contributed 94.5% of crude ore and 96% of total material handled in 1974. Both percentages were relatively unchanged from that of 1973, although there were minor shifts in percentages among the various commodities.

During the past 15 years, as indicated in table 1, total material handled during underground mining for metals decreased slightly, while that for nonmetal underground mining increased 50%. On balance, however, the percentage of all minerals mined by underground methods during this period of time has remained relatively constant.

Crude ore production at surface metal mines was nearly 7 times higher than that at underground metal mines, while total material handled was nearly 19 times higher at surface mines than at underground mines. Of the 2.7 billion tons of total material handled at nonmetal mines, nearly 97% was from surface operations.

Two metal commodities, lead and zinc, and three nonmetal commodities, potassium salts, sodium carbonate, and wollastonite, were mined entirely by underground methods. Crude ore production of 8 metals and 19 nonmetals came entirely from surface mines.

Underground mining accounted for a substantial percentage of crude ore output in four States: New Mexico (32%), Wyoming (32%), Colorado (31%), and Missouri (28%). No underground activity was reported in 16 States.

Ratio of Ore Treated to Marketable Prod-

uct.—The ratio of ore treated to marketable product, that is, the amount of ore processed to produce one unit of marketable product, varies with the type of mineral commodity. The ratio ultimately depends on the grade of ore treated and type of valuable mineral content. For many of the nonmetal commodities, the ratio is essentially 1 to 1. Ratios are significantly lower for underground mines than for surface mines for a specific commodity because of higher mining costs. The historical trend for most mineral commodities that are concentrated has been an increase in ratio as ores with smaller valuable mineral contents are mined and processed.

Exploration and Development.—Exploration and development work in 1974 increased 2%, compared with that of 1973, reversing the downward trend that had persisted since 1969. All of the increase came from increased development work at both metal and nonmetal mines. In contrast, exploration work was down slightly. Exploration work for nonmetals increased 34%, but failed to offset a 2% decrease in activity for metals.

Metal mines accounted for 69% of all development work and 96% of exploration activities. Development work at metal mines increased significantly primarily because of underground work at lead, zinc, and uranium mines, while increased development at nonmetal mines was the result of work conducted for sodium carbonate.

Exploration drilling footage decreased, except for diamond drilling footage which rose 15%. Exploration trenching footage more than doubled, compared with that of 1973; footage for metals increased 73%, and nonmetal footage increased nearly 6-fold.

As in 1973, four States reported over 1 million feet of exploration and development work. Wyoming led with 30% of total footage reported, followed by South Dakota (20%), New Mexico (19%), and Texas (11%). Exploration activity increased significantly in Utah and Tennessee for copper, in Idaho and Missouri for lead and zinc, in Minnesota for iron ore, and in Florida for phosphate rock. Rotary drilling accounted for 63% of all exploration footage, decreasing from 64% in 1973. Drifting and crosscutting accounted for 82% of the development work.

Stripping activity, primarily for copper in Arizona, accounted for 93% of total material produced in mine development in 1974. Other commodities that contributed significant material produced in development activities were iron ore in Minnesota and uranium in Wyoming. Michigan accounted for the largest quantity of total material produced in shaft and winze sinking, Arizona the largest quantity in raising, and Wyoming the largest quantity in drifting, crosscutting, or tunneling.

Explosives.—Apparent consumption of industrial explosives and blasting agents in the United States in 1974 was 2,762 million pounds, establishing a record high for the sixth consecutive year. However, consumption in the minerals industry decreased nearly 5%, compared with that of 1973. Overall, coal mining consumed 43%, quarrying 20%, and metal mining 17% of all industrial explosives and blasting agents.

Coal mining continued as the leading minerals industry consumer of permissible explosives (96% of the total), cylindrically packed blasting agents (87%), and other processed blasting agents and unprocessed ammonium nitrate (58%). The leading consumer of other high explosives was quarrying (65%) while metal mining was the chief user of water gels and slurries (62% of the total). Of the 2.2 million pounds of explosives consumed in the minerals industry, coal mining continued to be the leading user with 54% of the total, followed by quarrying and nonmetal mining (25%), and metal mining (21%). Although coal mining consumption increased about 1%, reduced usage in metal and nonmetal mining caused the lower usage in the minerals industry.

Kentucky, Pennsylvania, and Alabama continued to be the leading States in explosive consumption for coal mining, accounting for 47% of the total. Arizona and Minnesota were leading States for metal mining, accounting for 55% of the explosives used in metal mining. For nonmetal mining and quarrying, Pennsylvania, Illinois, and Ohio were leading States, accounting for 23% of explosives used in this category.

Beginning in 1972, the Institute of Makers of Explosives (IME) adopted new product classifications for industrial explosives and blasting agents. As a result, detailed data are not directly comparable with those of previous years.

More detailed explosives information is

published in the Annual Explosives issue, Mineral Industry Surveys, prepared by the Division of Nonmetallic Minerals, Minerals and Materials Supply/Demand Analysis, Bureau of Mines.

Table 1.—Material handled at surface and underground mines in the United States by type

(Million short tons)

Type and year	Surface			Underground			All mines [1]		
	Crude ore	Waste	Total [1]	Crude ore	Waste	Total [1]	Crude ore	Waste	Total
Metals:									
1960	336	508	844	86	8	94	421	516	938
1961	340	415	755	83	7	91	423	422	846
1962	346	434	780	76	7	83	422	441	863
1963	354	463	817	76	7	83	430	470	900
1964	376	455	830	83	7	90	458	462	920
1965	390	505	895	87	6	94	477	511	989
1966	412	634	1,050	88	7	95	500	641	1,140
1967	353	619	972	74	7	81	427	626	1,050
1968	402	717	1,120	79	13	92	481	730	1,210
1969	455	941	1,400	85	13	98	540	954	1,490
1970	499	968	1,470	87	7	94	586	975	1,560
1971	480	1,020	1,500	80	6	86	560	1,020	1,580
1972	491	1,080	1,570	86	5	91	576	1,080	1,660
1973	574	1,280	1,860	82	9	91	655	1,290	1,950
1974	547	1,210	1,760	80	11	91	627	1,220	1,850
Nonmetals:									
1960	1,550	236	1,790	57	1	58	1,610	236	1,850
1961	1,590	188	1,780	65	1	66	1,660	190	1,850
1962	1,590	224	1,810	62	1	63	1,650	225	1,880
1963	1,640	261	1,900	67	2	69	1,710	263	1,970
1964	1,740	277	2,010	69	2	71	1,800	279	2,080
1965	1,850	296	2,140	78	3	81	1,930	299	2,220
1966	1,930	368	2,300	77	2	79	2,010	370	2,380
1967	1,910	399	2,310	78	3	81	1,990	402	2,390
1968	1,870	413	2,280	78	3	81	1,950	416	2,360
1969	2,000	375	2,380	80	2	82	2,080	377	2,460
1970	2,010	431	2,440	80	4	84	2,090	435	2,530
1971	1,980	442	2,420	73	5	78	2,050	447	2,500
1972	2,020	415	2,430	77	5	82	2,100	420	2,520
1973	2,240	418	2,650	82	1	83	2,320	419	2,740
1974	2,220	418	2,640	82	5	87	2,300	423	2,720
Total metals and nonmetals: [1]									
1960	1,890	744	2,630	143	9	152	2,030	753	2,780
1961	1,930	603	2,540	148	9	156	2,080	612	2,690
1962	1,940	658	2,590	138	8	146	2,070	666	2,740
1963	1,990	724	2,720	142	9	152	2,140	734	2,870
1964	2,110	731	2,840	152	9	161	2,260	740	3,000
1965	2,240	801	3,040	165	9	175	2,400	810	3,210
1966	2,340	1,000	3,340	165	9	174	2,510	1,010	3,520
1967	2,260	1,020	3,280	152	10	162	2,410	1,030	3,440
1968	2,270	1,130	3,400	157	16	173	2,430	1,150	3,580
1969	2,460	1,320	3,770	165	15	180	2,620	1,330	3,950
1970	2,510	1,400	3,910	167	11	178	2,680	1,410	4,090
1971	2,460	1,460	3,920	153	11	164	2,610	1,470	4,080
1972	2,500	1,500	4,000	163	10	173	2,670	1,510	4,180
1973	2,810	1,700	4,510	163	11	174	2,970	1,710	4,680
1974	2,760	1,630	4,390	162	16	178	2,930	1,650	4,570

[1] Data may not add to totals shown because of independent rounding.

Table 2.—Material handled at surface and underground mines in 1974, by commodity[1]

(Thousand short tons)

Commodity	Surface			Underground			All mines[3]		
	Crude ore	Waste	Total[2]	Crude ore	Waste	Total[2]	Crude ore	Waste	Total
METALS									
Bauxite	[3]3,140	9,720	[3]12,900	W	--	W	3,140	9,720	12,900
Copper	261,000	764,000	1,020,000	31,900	1,260	33,200	293,000	765,000	1,060,000
Gold:									
Lode	2,660	9,050	11,700	1,630	199	1,830	4,290	9,250	13,500
Placer	1,480	221	1,700	--	5	5	1,480	226	1,710
Iron ore	230,000	251,000	481,000	10,000	1,580	11,600	240,000	252,000	492,000
Lead	1	2	3	10,500	2,640	13,200	10,500	2,640	13,200
Mercury	23	563	586	8	1	9	31	564	595
Silver	31	28	59	599	239	838	629	268	897
Titanium, ilmenite	32,600	5,240	37,900	--	--	--	32,600	5,240	37,900
Tungsten	16	19	35	747	130	876	762	149	911
Uranium	3,870	143,000	147,000	2,450	1,570	4,020	6,320	144,000	151,000
Zinc	1	35	36	8,270	2,380	10,600	8,270	2,410	10,700
Other[4]	12,200	29,300	41,500	13,700	991	14,700	25,900	30,300	56,100
Total metals[2]	547,000	1,210,000	1,760,000	79,900	11,000	90,800	627,000	1,220,000	1,850,000
NONMETALS									
Abrasives[5]	304	183	487	41	--	41	345	183	528
Asbestos	[3]1,470	371	[3]1,840	W	--	W	1,470	371	1,840
Barite	[3]1,960	[3]2,370	[3]4,340	W	W	W	1,960	2,370	4,340
Clays	53,300	[e]46,300	99,600	988	[e]14	1,000	54,200	46,300	101,000
Diatomite	666	6,210	6,870	--	--	--	666	6,210	6,870
Feldspar	1,190	163	1,350	--	--	--	1,190	163	1,350
Fluorspar	14	41	55	598	88	687	612	129	742
Gypsum	9,910	12,400	22,300	2,490	26	2,510	12,400	12,400	24,800
Mica (scrap)	887	745	1,630	--	--	--	887	745	1,630
Perlite	[3]677	44	[3]721	W	--	W	677	44	721
Phosphate rock	154,000	242,000	396,000	297	239	536	155,000	242,000	397,000
Potassium salts	--	--	--	17,200	461	17,700	17,200	461	17,700
Pumice	3,930	144	4,070	--	--	--	3,930	141	4,070
Salt	278	74	353	13,100	663	13,800	13,400	737	14,200
Sand and gravel	974,000	--	974,000	--	--	--	974,000	--	974,000
Sodium carbonate (natural)	--	--	--	7,520	3,160	10,700	7,520	3,160	10,700
Stone:									
Crushed and broken	1,000,000	[e]82,400	1,080,000	39,000	[e]313	39,300	1,040,000	82,700	1,120,000
Dimension	[e]3,070	[e]1,620	4,690	45	--	45	3,120	1,620	4,740
Other[6]	9,430	23,500	33,000	533	9	541	9,960	23,500	33,500
Total nonmetals[2]	2,220,000	418,000	2,640,000	82,000	5,050	87,100	2,300,000	423,000	2,720,000
Grand total[2]	2,760,000	1,630,000	4,390,000	162,000	16,000	178,000	2,930,000	1,650,000	4,570,000

[e] Estimate. W Withheld to avoid disclosing individual company confidential data, included with "Surface."

[1] Excludes material from wells, ponds, or pumping operations.

[2] Data may not add to totals shown because of independent rounding.

[3] Includes underground; the Bureau of Mines is not at liberty to publish separately.

[4] Antimony, beryllium, manganiferous ore, molybdenum, nickel, platinum-group metals, rare-earth metals, tin, and vanadium.

[5] Abrasive stone, emery, garnet, and tripoli.

[6] Aplite, boron minerals, graphite, greensand marl, iron oxide pigments (crude), kyanite, lithium minerals, magnesite, mica (sheet), millstones, olivine, talc, soapstone and pyrophyllite, vermiculite, and wollastonite.

Table 3.—Material handled at surface and underground mines (including sand and gravel and stone) in 1974 by State [1]
(Thousand short tons)

State	Surface			Underground			All mines [2]		
	Crude ore	Waste	Total [2]	Crude ore	Waste	Total [2]	Crude ore	Waste	Total
Alabama	39,300	5,860	45,100	W	--	W	39,300	5,860	45,100
Alaska	127,000	235	127,000	([3])	1	1	127,000	237	127,000
Arizona	187,000	447,000	635,000	20,900	1,110	22,100	208,000	449,000	657,000
Arkansas	38,900	8,640	47,500	749	74	823	39,700	8,710	48,400
California	171,000	71,300	243,000	971	137	1,110	172,000	71,400	244,000
Colorado	33,800	4,300	38,100	15,300	1,720	17,000	49,100	6,010	55,200
Connecticut	15,100	5	15,100	--	--	--	15,100	5	15,100
Delaware	2,410	--	2,410	--	--	--	2,410	--	2,410
Florida	235,000	169,000	404,000	--	--	--	235,000	169,000	404,000
Georgia	54,600	2,740	57,300	1,210	--	1,210	55,800	2,740	58,500
Hawaii	9,010	5	9,020	--	--	--	9,010	5	9,020
Idaho	17,800	36,000	53,900	1,680	635	2,320	19,500	36,700	56,200
Illinois	104,000	41	104,000	3,580	88	3,660	108,000	124	108,000
Indiana	58,100	--	58,100	1,110	--	1,110	59,200	--	59,200
Iowa	49,400	2,410	51,800	2,300	--	2,300	51,700	2,410	54,100
Kansas	28,500	--	28,500	3,010	26	3,040	31,500	26	36,600
Kentucky	36,600	--	36,600	7,620	1	7,620	44,200	1	44,200
Louisiana	24,500	--	24,500	5,030	171	5,200	29,500	171	29,700
Maine	5,390	--	5,390	W	W	W	5,390	--	5,390
Maryland	30,500	--	30,500	W	--	W	30,500	--	30,500
Massachusetts	25,700	--	25,700	--	--	--	25,700	--	25,700
Michigan	139,000	33,000	172,000	11,900	116	12,000	151,000	33,100	184,000
Minnesota	216,000	145,000	362,000	--	--	--	216,000	145,000	362,000
Mississippi	18,200	--	18,200	--	--	--	18,200	--	18,200
Missouri	56,100	1,740	57,800	21,900	3,120	25,000	78,000	4,850	82,800
Montana	33,900	69,100	103,000	1,210	254	1,460	35,100	69,300	104,000
Nebraska	16,900	--	16,900	1,170	--	1,170	18,000	--	18,000
Nevada	36,800	63,400	100,000	406	55	461	37,200	63,400	101,000
New Hampshire	6,750	--	6,750	--	--	--	6,750	--	6,750
New Jersey	44,900	2,070	47,000	W	--	W	44,900	2,070	47,000
New Mexico	42,500	122,000	164,000	19,600	1,490	21,100	62,100	123,000	185,000
New York	75,600	6,880	82,500	6,000	111	6,120	81,600	6,990	88,600
North Carolina	57,100	23,300	80,400	W	--	W	57,100	23,300	80,400
North Dakota	5,110	--	5,110	--	--	--	5,110	--	5,110
Ohio	95,900	--	95,900	4,490	483	4,970	100,000	483	101,000
Oklahoma	32,000	11,400	43,400	W	--	W	32,000	11,400	43,400
Oregon	45,000	601	45,600	6	2	8	45,000	603	45,600
Pennsylvania	90,700	11	90,700	6,260	514	6,770	96,900	525	97,500
Rhode Island	3,210	--	3,210	--	--	--	3,210	--	3,210
South Carolina	24,300	744	25,000	--	--	--	24,300	744	25,000
South Dakota	12,400	6	12,400	W	W	W	12,400	6	12,400
Tennessee	56,000	9,930	65,900	6,650	995	7,650	62,600	10,900	73,500
Texas	116,000	29,000	145,000	W	W	W	116,000	29,000	145,000
Utah	55,800	118,000	174,000	676	422	1,100	56,400	118,000	175,000
Vermont	5,280	111	5,390	201	--	201	5,480	111	5,590
Virginia	58,700	11	58,700	2,380	641	3,020	61,100	652	61,700
Washington	38,100	863	38,900	291	146	437	38,400	1,010	39,400
West Virginia	14,600	--	14,600	2,330	--	2,330	16,900	--	16,900
Wisconsin	53,900	4,860	58,700	542	15	556	54,400	4,880	59,300
Wyoming	17,900	109,000	127,000	8,560	3,180	11,700	26,400	112,000	138,000
Undistributed [4]	1,680	130,000	132,000	3,840	534	4,370	5,510	131,000	136,000
Total [2]	2,760,000	1,630,000	4,390,000	162,000	16,000	178,000	2,930,000	1,650,000	4,570,000

W Withheld to avoid disclosing individual company confidential data; included with "Undistributed."
[1] Excludes material from wells, ponds, or pumping operations.
[2] Data may not add to totals shown because of independent rounding.
[3] Less than ½ unit.
[4] Includes estimated data in table 2.

Table 4.—Value of principal mineral products and byproducts of surface and underground ores mined in the United States in 1974

(Value per ton)

Ore	Surface			Underground			All mines		
	Principal mineral product	By-product	Total	Principal mineral product	By-product	Total	Principal mineral product	By-product	Total
METALS									
Bauxite	[1] $8.17	$2.31	[1] $10.48	W	--	W	$8.17	$2.31	$10.48
Copper	7.75	.67	8.42	$12.67	$1.22	$13.89	8.28	.73	9.01
Gold:									
Lode	14.94	.11	15.05	36.40	.61	37.01	22.71	.29	23.00
Placer	1.33	--	1.33	--	--	--	1.33	--	1.33
Iron ore	5.61	--	5.61	10.25	.10	10.35	5.80	--	5.80
Lead	13.21	10.35	23.56	26.78	15.12	41.90	26.77	15.11	41.88
Mercury	8.25	--	8.25	39.88	--	39.88	16.94	--	16.94
Silver	7.06	3.43	10.49	77.13	12.75	89.88	70.10	11.82	81.92
Titanium, ilmenite	.72	.43	1.15	--	--	--	.72	.42	1.15
Uranium	34.80	.02	34.82	34.16	4.55	38.71	34.53	1.96	36.49
Zinc	9.83	3.29	13.12	30.68	6.04	36.72	30.66	6.04	36.70
Average value [2]	6.58	.36	6.94	17.58	3.49	21.07	7.98	.76	8.74
NONMETALS									
Asbestos	[1] 8.05	.03	[1] 8.08	W	--	W	8.05	.03	8.08
Barite	[1] 8.90	.15	[1] 9.05	W	--	W	8.90	.15	9.05
Clays	7.44	--	7.44	10.13	--	10.13	7.49	--	7.49
Diatomite	76.08	--	76.08	--	--	--	76.08	--	76.08
Feldspar	9.59	.95	10.54	--	--	--	9.59	.95	10.54
Fluorspar	37.76	--	37.76	22.55	5.57	28.12	23.48	5.23	28.71
Gypsum	3.94	.08	4.02	5.57	--	5.57	4.25	.06	4.32
Mica (scrap)	9.04	--	9.04	--	--	--	9.04	--	9.04
Perlite	[1] 9.24	--	[1] 9.24	W	--	W	9.24	--	9.24
Phosphate rock	3.22	.05	3.27	13.51	--	13.51	3.24	.05	3.29
Potassium salts	--	--	--	7.49	.01	7.50	7.49	.01	7.50
Pumice	2.41	--	2.41	--	--	--	2.41	--	2.41
Salt	3.37	1.42	4.79	7.11	.33	7.44	7.03	.35	7.38
Sand and gravel	1.49	--	1.49	--	--	--	1.49	--	1.49
Sodium carbonate (natural)	--	--	--	16.97	--	16.97	16.97	--	16.97
Stone:									
Crushed and broken	2.45	.01	2.46	2.44	.01	2.45	2.45	.01	2.46
Dimension	53.41	--	53.41	90.06	--	90.06	54.54	--	54.54
Average value [2]	2.33	.01	2.34	6.09	.10	6.19	2.47	.01	2.48
Average value—metals and nonmetals [2]	3.17	.08	3.25	11.77	1.77	13.54	3.65	.17	3.82
Average value—nonmetals (excluding stone, and sand and gravel) [2]	5.02	.06	5.08	9.31	.18	9.49	5.68	.08	5.76
Average value—metals and nonmetals (excluding stone, and sand and gravel) [2]	6.11	.27	6.38	14.69	2.33	17.02	7.27	.55	7.82

W Withheld to avoid disclosing individual company confidential data; included with "Surface."

[1] Includes underground; the Bureau of Mines is not at liberty to publish separately.

[2] Includes unpublished data.

Table 5.—Crude ore and total material handled at surface and underground mines in 1974, by commodity

(Percent)

Commodity	Crude ore		Total material	
	Surface	Underground	Surface	Underground
METALS				
Antimony	0.2	99.8	3.1	96.9
Bauxite	[1] 100.0	W	[1] 100.0	W
Beryllium	100.0	--	100.0	--
Copper	89.1	10.9	96.9	3.1
Gold:				
Lode	62.0	38.0	86.5	13.5
Placer	100.0	--	99.7	.3
Iron ore	9.5	4.2	97.6	2.4
Lead	--	100.0	--	100.0
Mercury	73.7	26.3	98.5	1.5
Molybdenum	32.6	67.4	69.1	30.9
Nickel	100.0	--	100.0	--
Platinum-group metals	100.0	--	100.0	--
Rare-earth metals	100.0	--	100.0	--
Silver	4.9	95.1	6.6	93.4
Tin	100.0	--	100.0	--
Titanium, ilmenite	100.0	--	100.0	--
Tungsten	2.0	98.0	3.8	96.2
Uranium	61.2	38.8	97.3	2.7
Vanadium	100.0	--	100.0	--
Zinc	--	100.0	.3	99.7
Total metals	87.3	12.7	95.1	4.9
NONMETALS				
Abrasive stone	100.0	--	100.0	--
Aplite	100.0	--	100.0	--
Asbestos	[1] 100.0	W	[1] 100.0	W
Barite	[1] 100.0	W	[1] 100.0	W
Boron minerals	100.0	--	100.0	--
Clays	98.2	1.8	98.2	1.8
Diatomite	100.0	--	100.0	--
Emery	100.0	--	100.0	--
Feldspar	100.0	--	100.0	--
Fluorspar	2.3	97.7	7.4	92.6
Garnet	100.0	--	100.0	--
Graphite	100.0	--	100.0	--
Greensand marl	100.0	--	100.0	--
Gypsum	79.9	20.1	89.9	10.1
Iron oxide pigments (crude)	47.7	52.3	65.2	34.8
Kyanite	100.0	--	100.0	--
Lithium minerals	100.0	--	100.0	--
Magnesite	100.0	--	100.0	--
Mica (scrap)	100.0	--	100.0	--
Mica (sheet)	100.0	--	100.0	--
Millstones	100.0	--	100.0	--
Olivine	100.0	--	100.0	--
Perlite	[1] 100.0	W	[1] 100.0	W
Phosphate rock	99.8	.2	99.9	.1
Potassium salts	--	100.0	--	100.0
Pumice	100.0	--	100.0	--
Salt	2.1	97.9	2.5	97.5
Sand and gravel	100.0	--	100.0	--
Sodium carbonate (natural)	--	100.0	--	100.0
Stone:				
Crushed and broken	96.3	3.7	96.3	3.7
Dimension	96.9	3.1	96.9	3.1
Talc, soapstone, pyrophyllite	59.8	40.2	87.3	12.7
Tripoli	55.2	44.8	66.9	33.1
Vermiculite	100.0	--	100.0	--
Wollastonite	--	100.0	--	100.0
Total nonmetals	96.4	3.6	96.7	3.3
Grand total	94.5	5.5	96.0	4.0

W Withheld to avoid disclosing individual company confidential data; included with "Surface."

[1] Includes underground; the Bureau of Mines is not at liberty to publish separately.

Table 6.—Crude ore and total material handled at surface and underground mines in 1974, by State

(Percent)

State	Crude ore		Total material	
	Surface	Underground	Surface	Underground
Alabama	[1]100	W	[1]100	W
Alaska	100	--	100	--
Arizona	90	10	97	3
Arkansas	98	2	98	2
California	99	1	100	--
Colorado	69	31	69	31
Connecticut	100	--	100	--
Delaware	100	--	100	--
Florida	100	--	100	--
Georgia	98	2	98	2
Hawaii	100	--	100	--
Idaho	91	9	96	4
Illinois	97	3	97	3
Indiana	98	2	98	2
Iowa	96	4	96	4
Kansas	90	10	90	10
Kentucky	83	17	83	17
Louisiana	83	17	83	17
Maine	[1]100	W	[1]100	W
Maryland	[1]100	W	[1]100	W
Massachusetts	100	--	100	--
Michigan	92	8	94	6
Minnesota	100	--	100	--
Mississippi	100	--	100	--
Missouri	72	28	70	30
Montana	97	3	99	1
Nebraska	94	6	94	6
Nevada	99	1	100	--
New Hampshire	100	--	100	--
New Jersey	100	--	100	--
New Mexico	68	32	89	11
New York	93	7	93	7
North Carolina	100	--	100	--
North Dakota	100	--	100	--
Ohio	96	4	95	5
Oklahoma	[1]100	W	[1]100	W
Oregon	100	--	100	--
Pennsylvania	94	6	93	7
Rhode Island	100	--	100	--
South Carolina	100	--	100	--
South Dakota	[1]100	W	[1]100	W
Tennessee	89	11	90	10
Texas	100	--	100	--
Utah	99	1	99	1
Vermont	96	4	96	4
Virginia	96	4	95	5
Washington	99	1	99	1
West Virginia	86	14	86	14
Wisconsin	99	1	99	1
Wyoming	68	32	92	8
Total	95	5	96	4

W Withheld to avoid disclosing individual company confidential data; included with "Surface."

[1] Includes underground; the Bureau of Mines is not at liberty to publish separately.

Table 7.—Number of domestic metal and nonmetal mines in 1974, by commodity and magnitude of crude ore production[1]

Commodity	Total number of mines	Less than 1,000 tons	1,000 to 10,000 tons	10,000 to 100,000 tons	100,000 to 1,000,000 tons	1,000,000 to 10,000,000 tons	more than 10,000,000 tons
METALS							
Bauxite	16	--	2	10	3	1	--
Copper	71	20	5	5	10	21	10
Gold:							
Lode	54	37	11	2	2	2	--
Placer	31	12	10	7	2	--	--
Iron ore	76	--	10	15	20	27	4
Lead	49	26	6	3	9	5	--
Mercury	14	6	7	1	--	--	--
Silver	77	55	13	7	2	--	--
Titanium, ilmenite	7	--	--	--	--	7	--
Tungsten	34	27	4	2	1	--	--
Uranium	153	18	79	40	16	--	--
Zinc	39	8	1	9	20	1	--
Other[2]	16	6	1	2	2	4	1
Total metals	637	215	149	103	87	68	15
NONMETALS							
Abrasives[3]	12	1	7	3	1	--	--
Asbestos	6	--	1	3	1	1	--
Barite	37	--	10	22	5	--	--
Boron minerals	2	--	--	--	1	1	--
Clays	1,355	61	449	716	129	--	--
Diatomite	16	--	10	4	2	--	--
Feldspar	26	7	8	6	5	--	--
Fluorspar	11	1	6	1	3	--	--
Gypsum	75	1	5	29	40	--	--
Mica (scrap)	15	2	4	5	4	--	--
Perlite	12	1	4	5	2	--	--
Phosphate rock	43	2	4	3	13	15	6
Potassium salts	7	--	--	1	--	6	--
Pumice	222	13	117	87	5	--	--
Salt	16	--	--	3	6	7	--
Sand and gravel	6,967	150	1,048	3,489	2,193	84	3
Sodium carbonate (natural)	3	--	--	--	--	3	--
Stone:							
Crushed and broken	5,043	383	750	1,979	1,764	172	1
Dimension	417	221	168	27	1	--	--
Talc, soapstone	33	3	16	10	4	--	--
Vermiculite	5	--	1	--	3	1	--
Other[4]	24	7	4	8	5	--	--
Total nonmetals	14,353	853	2,612	6,401	4,187	290	10
Grand total	14,990	1,068	2,761	6,504	4,274	358	25

[1] Excludes wells, ponds, or pumping operations.

[2] Antimony, beryllium, manganiferous ore, molybdenum, nickel, platinum-group metals, rare-earth metals, tin, and vanadium.

[3] Abrasive stone, emery, garnet, and tripoli.

[4] Aplite, graphite, greensand marl, iron oxide pigments (crude), kyanite, lithium minerals, magnesite, mica (sheet), millstones, olivine, and wollastonite.

Table 8.—Twenty-five leading metal and nonmetal[1] mines in the United States in 1974, in order of output of crude ore

Mine	State	Operator	Commodity	Mining method
METALS				
Minntac	Minn	United States Steel Corp.	Iron ore	Open pit.
Utah Copper	Utah	Kennecott Copper Corp.	Copper	Do.
Erie Commercial (Hoyt Lake)	Minn	Pickands Mather & Co.	Iron ore	Do.
Peter Mitchell	do	Reserve Mining Co	do	Do.
Sierrita	Ariz	Duval Sierrita Corp	Copper	Do.
Pima	do	Cyprus Pima Mining Co.	do	Do.
San Manuel	do	Magma Copper Co	do	Caving.
Berkeley Pit	Mont	The Anaconda Company	do	Open pit.

See footnote at end of table.

Table 8.—Twenty-five leading metal and nonmetal[1] mines in the United States in 1974, in order of output of crude ore—Continued

Mine	State	Operator	Commodity	Mining method
		METALS—Continued		
Morenci	Ariz	Phelps Dodge Corp	Copper	Open pit.
Tyrone	N. Mex	do	do	Do.
Climax	Colo	American Metal Climax, Inc.	Molybdenum	Caving.
Empire	Mich	Cleveland-Cliffs Iron Co.	Iron ore	Open pit.
Twin Buttes	Ariz	Anamax Mining Co	Copper	Do.
Ray Pit	do	Kennecott Copper Corp.	do	Do.
Yerington	Nev	The Anaconda Company.	do	Do.
Eagle Mountain	Calif	Kaiser Steel Corp	Iron ore	Do.
Butler Project	Minn	Hanna Mining Co	do	Do.
New Cornelia	Ariz	Phelps Dodge Corp	Copper	Do.
Republic	Mich	Cleveland-Cliffs Iron Co.	Iron ore	Do.
Highland	Fla	E.I. du Pont de Nemours & Co.	Titanium	Dredging.
Inspiration	Ariz	Inspiration Consolidated Copper Co.	Copper	Open pit.
White Pine	Mich	White Pine Copper Co.	do	Open stopes.
Lakehurst	N. J	American Smelting and Refining Co.	Titanium	Dredging.
Trail Ridge	Fla	E.I. du Pont de Nemours & Co.	do	Do.
Chino	N. Mex	Kennecott Copper Corp.	Copper	Open pit.
		NONMETALS		
Suwannee	Fla	Occidental Petroleum Corp.	Phosphate rock	Open pit.
Calcite	Mich	United States Steel Corp.	Stone	Open quarry.
Kingsford	Fla	International Minerals & Chemical Corp.	Phosphate rock	Open pit.
Ft. Meade	do	Mobil Oil Corp	do	Do.
Noralyn	do	International Minerals & Chemical Corp.	do	Do.
Payne Creek	do	Continental Oil Co	do	Do.
Palmetto	do	do	do	Do.
Haynsworth	do	American Cyanamid Co.	do	Do.
Rockland	do	United States Steel Corp.	do	Do.
Clear Spring	do	International Minerals & Chemical Corp.	do	Do.
Stoneport	Mich	Presque Isle Corp	Stone	Open quarry.
Thornton	Ill	General Dynamics Corp.	do	Do.
Pennsuco	Fla	Maule Industries, Inc	do	Dredging.
Nichols	do	Mobil Oil Corp	Phosphate rock	Open pit.
Feld	Tex	Texas Crushed Stone Co.	Stone	Open quarry.
Bonny Lake	Fla	W. R. Grace & Co	Phosphate rock	Open pit.
Lee Creek	N. C	Texasgulf Inc	do	Do.
Tampa Agricultural Chemical Operations	Fla	Gardinier, Inc	do	Do.
Cedarville	Mich	United States Steel Corp.	Stone	Open quarry.
International	N. Mex	International Minerals & Chemical Corp.	Potassium salts	Open stopes.
Silver City	Fla	Swift Agricultural Chemicals Corp.	Phosphate rock	Open pit.
Permanente	Calif	Kaiser Cement & Gypsum Corp.	Stone	Open quarry.
Clinton	N.Y	Lone Star Industries, Inc.	do	Do.
Alpena	Mich	Huron Portland Cement Co.	do	Do.
Beckman	Tex	McDonough Bros., Inc.	do	Do.

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[1] Brines and materials from wells excepted.

Table 9.—Twenty-five leading metal and nonmetal[1] mines in the United States in 1974, in order of output of total materials handled

Mine	State	Operator	Commodity	Mining method
		METALS		
Utah Copper	Utah	Kennecott Copper Corp.	Copper	Open pit.
Twin Buttes	Ariz	Anamax Mining Co	do	Do.
Minntac	Minn	United States Steel Corp.	Iron ore	Do.
Sierrita	Ariz	Duval Sierrita Corp	Copper	Do.
Berkeley Pit	Mont	The Anaconda Co	do	Do.
Tyrone	N. Mex	Phelps Dodge Corp	do	Do.
Eagle Mountain	Calif	Kaiser Steel Corp	Iron ore	Do.
Erie Commercial (Hoyt Lake)	Minn	Pickands Mather & Co	do	Do.
Pima	Ariz	Cyprus Pima Mining Co.	Copper	Do.
Morenci	do	Phelps Dodge Corp	do	Do.
Mitchell Pit	Minn	Reserve Mining Co	Iron ore	Do.
Ray Pit	Ariz	Kennecott Copper Corp.	Copper	Do.
Ruth	Nev	do	do	Do.
Shirley Basin	Wyo	Utah International Inc.	Uranium	Do.
Chino	N. Mex	Kennecott Copper Corp.	Copper	Do.
Sacaton	Ariz	American Smelting and Refining Co.	do	Do.
Inspiration	do	Inspiration Consolidated Copper Corp.	do	Do.
Questa	N. Mex	Molybdenum Corp. of America	Molybdenum	Do.
Lucky Mc	Wyo	Utah International Inc.	Uranium	Do.
Mission	Ariz	American Smelting and Refining Co.	Copper	Do.
Empire	Mich	Cleveland-Cliffs Iron Co.	Iron ore	Do.
New Cornelia	Ariz	Phelps Dodge Corp	Copper	Do.
San Manuel	do	Magma Copper Co	do	Caving.
Climax	Colo	American Metal Climax, Inc.	Molybdenum	Do.
Yerington	Nev	The Anaconda Co	Copper	Open pit.
		NONMETALS		
Kingsford	Fla	International Minerals & Chemical Corp.	Phosphate rock	Open pit.
Noralyn	do	do	do	Do.
Suwannee	do	Occidental Petroleum Corp.	do	Do.
Haynsworth	do	American Cyanamid Co.	do	Do.
Rockland	do	United States Steel Corp.	do	Do.
Lee Creek	N. C	Texasgulf, Inc	do	Do.
Bonny Lake	Fla	W. R. Grace & Co	do	Do.
Clear Spring	do	International Minerals & Chemical Corp.	do	Do.
Ft. Meade	do	Mobil Oil Corp	do	Do.
Watson	do	Swift Agricultural Chemicals Corp.	do	Do.
Mabie Canyon	Idaho	Agricultural Products Corp.	do	Do.
Calcite	Mich	United States Steel Corp.	Stone	Open quarry.
Gay	Idaho	J. R. Simplot Co	Phosphate rock	Open pit.
Nichols	Fla	Mobil Oil Corp	do	Do.
Payne Creek	do	Continental Oil Co	do	Do.
Tampa Agricultural Chemical Operations	do	Gardinier, Inc	do	Do.
Palmetto	do	Continental Oil Co	do	Do.
Boron	Calif	U.S. Borax & Chemical Corp.	Boron	Do.
Silver City.	Fla	Swift Agricultural Chemicals Corp.	Phosphate rock	Do.
Stoneport	Mich	Presque Isle Corp	Stone	Open quarry.

See footnote at end of table.

Table 9.—Twenty-five leading metal and nonmetal[1] mines in the United States in 1974, in order of output of total materials handled—Continued

Mine	State	Operator	Commodity	Mining method
NONMETALS—Continued				
Kern Borate	Calif	Tenneco Inc	Boron	Open pit.
Thornton	Ill	General Dynamics Corp.	Stone	Open quarry.
Pennsuco	Fla	Maule Industries, Inc.	do	Dredging.
Westvaco	Wyo	FMC Corporation	Sodium carbonate	Artificial stopes.
Feld	Tex	Texas Crushed Stone Co.	Stone	Open quarry.

[1] Brines and materials from wells excepted.

Table 10.—Ore treated or sold per unit of marketable product at surface and underground mines in the United States in 1974, by commodity

Commodity	Unit of marketable product	Surface			Underground			Total [1]		
		Ore treated (thousand short tons)	Marketable product (units)	Ratio of units of ore to units of marketable product	Ore treated (thousand short tons)	Marketable product (units)	Ratio of units of ore to units of marketable product	Ore treated (thousand short tons)	Marketable product (units)	Ratio of units of ore to units of marketable product
METALS										
Bauxite	thousand long tons	[2]3,140	[2]1,950	[2]1.6:1	W	W	W	3,140	1,950	1.6:1
Copper	thousand short tons	262,000	1,310	199.6:1	32,000	262	122.1:1	294,000	1,570	186.7:1
Gold:										
Lode	thousand troy ounces	2,870	268	10.7:1	1,630	372	4.4:1	4,500	640	7.0:1
Placer	do	1,480	12	120.2:1	--	--	--	1,480	12	120.2:1
Iron ore	thousand long tons	229,000	79,000	2.9:1	9,930	5,790	1.7:1	239,000	84,800	2.8:1
Lead	thousand short tons	5	([3])	34.0:1	10,400	618	16.8:1	10,400	618	16.8:1
Mercury	thousand flasks	21	1	34.1:1	8	1	7.1:1	29	2	16.6:1
Silver	thousand troy ounces	66	99	0.7:1	595	9,750	0.1:1	662	9,850	0.1:1
Titanium, ilmenite	thousand short tons	31,500	755	41.7:1	--	--	--	31,500	755	41.7:1
Uranium	do	4,040	7	603.4:1	3,020	5	614.7:1	7,060	12	608.2:1
Zinc	do	5	([3])	73.4:1	8,210	351	23.4:1	8,220	351	23.4:1
NONMETALS										
Asbestos	do	[2]1,660	[2]109	[2]15.3:1	W	W	W	1,660	109	15.3:1
Barite	do	[2]1,890	[2]1,110	[2]1.7:1	W	W	W	1,890	1,110	1.7:1
Clays	do	53,300	53,300	1.0:1	988	988	1.0:1	54,200	54,200	1.0:1
Diatomite	do	666	664	1.0:1	--	--	--	666	664	1.0:1
Feldspar	do	1,400	812	1.7:1	--	--	--	1,400	812	1.7:1
Fluorspar	do	37	34	1.1:1	572	167	3.4:1	609	201	3.0:1
Gypsum	do	9,920	9,430	1.1:1	2,490	2,570	1.0:1	12,400	12,000	1.0:1
Mica (scrap)	do	467	112	4.2:1	--	--	--	467	112	4.2:1
Perlite	do	[2]760	[2]555	[2]1.4:1	W	W	W	760	555	1.4:1
Phosphate rock	do	154,000	45,400	3.4:1	297	291	1.0:1	155,000	45,700	3.4:1
Potassium salts	do	--	--	--	17,200	2,100	8.2:1	17,200	2,100	8.2:1
Pumice	do	3,940	3,920	1.0:1	--	--	--	3,940	3,920	1.0:1
Salt	do	311	262	1.2:1	13,300	13,100	1.0:1	13,600	13,300	1.0:1
Sand and gravel	do	974,000	974,000	1.0:1	--	--	--	974,000	974,000	1.0:1
Sodium carbonate (natural)	do	--	--	--	7,500	3,790	2.0:1	7,500	3,790	2.0:1
Stone:										
Crushed and broken	do	1,010,000	1,000,000	1.0:1	39,000	38,000	1.0:1	1,050,000	1,040,000	1.0:1
Dimension	do	[e] 3,070	1,400	2.2:1	45	45	1.0:1	3,120	1,440	2.2:1
Tripoli	do	[2]90	[2]86	[2]1.1:1	W	W	W	90	86	1.1:1

[e] Estimate. W Withheld to avoid disclosing individual company confidential data; included with "Surface."

[1] Data may not add to totals shown because of independent rounding.

[2] Includes underground data; the Bureau of Mines is not at liberty to publish separately.

[3] Less than ½ unit.

Table 11.—Material handled per unit of marketable product at surface and underground mines in the United States in 1974, by commodity

Commodity	Unit of marketable product	Surface			Underground			Total[1]		
		Total material handled (thousand short tons)	Marketable product (units)	Ratio of units of material handled to units of marketable product	Total material handled (thousand short tons)	Marketable product (units)	Ratio of units of material handled to units of marketable product	Total material handled (thousand short tons)	Marketable product (units)	Ratio of units of material handled to units of marketable product
METALS										
Bauxite	thousand long tons	[2]12,900	[2]1,950	[2]5.1:1	W	W	W	12,900	1,950	5.1:1
Copper	thousand short tons	1,020,000	1,310	657.8:1	38,200	262	122.1:1	1,060,000	1,570	568.7:1
Gold:										
Lode	thousand troy ounces	11,700	268	38.4:1	1,830	372	4.4:1	13,500	640	18.7:1
Placer	do	1,700	12	121.1:1	5	--	--	1,710	12	121.1:1
Iron ore	thousand long tons	481,000	79,000	5.9:1	11,600	5,790	1.8:1	492,000	84,800	5.6:1
Lead	thousand short tons	3	(3)	5.9:1	13,200	618	18.2:1	13,200	618	18.2:1
Mercury	thousand flasks	586	1	358.3:1	9	1	7.3:1	595	2	131.3:1
Silver	thousand troy ounces	59	99	0.4:1	838	9,750	0.1:1	897	9,850	0.1:1
Titanium, ilmenite	thousand short tons	37,900	755	50.1:1	--	--	--	37,900	755	50.1:1
Uranium	do	147,000	7	15,091.7:1	4,020	5	615.3:1	151,000	12	8,969.1:1
Zinc	do	86	(3)	144.9:1	10,600	351	26.1:1	10,700	351	26.1:1
NONMETALS										
Asbestos	do	[2]1,840	[2]109	[2]16.8:1	W	W	W	1,840	109	16.8:1
Barite	do	[2]4,340	[2]1,110	[2]3.8:1	W	W	W	4,340	1,110	3.8:1
Clays	do	[e]99,600	53,300	1.9:1	1,000	988	1.0:1	101,000	54,200	1.9:1
Diatomite	do	6,870	664	10.3:1	--	--	--	6,870	664	10.3:1
Feldspar	do	1,350	812	1.7:1	--	--	--	1,350	812	1.7:1
Fluorspar	do	55	34	1.6:1	687	167	3.6:1	742	201	3.3:1
Gypsum	do	22,300	9,430	1.3:1	2,510	2,570	1.0:1	24,800	12,000	1.3:1
Mica (scrap)	do	1,630	112	14.6:1	--	--	--	1,630	112	14.6:1
Perlite	do	[2]721	[2]555	[2]1.3:1	W	W	W	721	555	1.3:1
Phosphate rock	do	396,000	45,400	8.6:1	586	291	1.0:1	397,000	45,700	8.5:1
Potassium salts	do	--	--	--	17,700	2,100	8.3:1	17,700	2,100	8.3:1
Pumice	do	4,070	3,920	1.0:1	--	--	--	4,070	3,920	1.0:1
Salt	do	353	262	1.3:1	13,800	13,100	1.1:1	14,200	13,300	1.1:1
Sand and gravel	do	974,000	974,000	1.0:1	--	--	--	974,000	974,000	1.0:1
Sodium carbonate (natural)	do	--	--	--	10,700	3,790	2.0:1	10,700	3,790	2.0:1
Stone:										
Crushed and broke	do	[e]1,080,000	1,000,000	1.1:1	[e]39,300	38,800	1.0:1	1,120,000	1,040,000	1.1:1
Dimension	do	[e]4,690	1,400	3.4:1	45	45	1.0:1	4,740	1,440	3.3:1
Tripoli	do	82	46	1.4:1	41	41	1.0:1	122	86	1.2:1

[e] Estimate. W Withheld to avoid disclosing individual company confidential data; included with "Surface."

[1] Data may not add to totals shown because of independent rounding.

[2] Includes underground data; the Bureau of Mines is not at liberty to publish separately.

[3] Less than ½ unit.

Table 12.—Mining methods used in open-pit mining in 1974, by commodity

(Percent)

Commodity	Total material handled: Preceded by drilling and blasting	Total material handled: Not preceded by drilling and blasting [1]
METALS		
Antimony	100	--
Bauxite	87	13
Beryllium	100	--
Copper	94	6
Gold:		
Lode	100	--
Placer	--	100
Iron ore	82	18
Lead	29	71
Manganiferous ore	100	--
Mercury	9	91
Molybdenum	100	--
Nickel	12	88
Platinum group metals	--	100
Rare-earth metals	100	--
Silver	70	30
Tin	--	100
Titanium, ilmenite	12	88
Tungsten	93	7
Uranium	21	79
Vanadium	50	50
Zinc	99	1
NONMETALS		
Abrasive stone	100	--
Aplite	100	--
Asbestos	66	34
Barite	25	75
Boron minerals	100	--
Clays	--	100
Diatomite	--	100
Emery	100	--
Feldspar	93	7
Fluorspar	100	--
Garnet	95	5
Graphite	100	--
Greensand marl	--	100
Gypsum	81	19
Iron oxide pigments (crude)	--	100
Kyanite	100	--
Lithium minerals	99	1
Magnesite	100	--
Mica (scrap)	10	90
Mica (sheet)	--	100
Millstones	85	15
Olivine	63	37
Perlite	43	57
Phosphate rock	5	95
Pumice	14	86
Salt	100	--
Sand and gravel	--	100
Stone:		
Crushed and broken	97	3
Dimension	--	100
Talc, soapstone, pyrophyllite	75	25
Tripoli	100	--
Vermiculite	58	42
Total	56	44

[1] Includes drilling or cutting without blasting, dredging, mechanical excavation and nonfloat washing, and other surface mining methods.

Table 13.—Exploration and development activity in the United States in 1974, by method

Method	Metals		Nonmetals		Total[1]	
	Feet	Percent of total[2]	Feet	Percent of total[2]	Feet	Percent of total[2]
DEVELOPMENT						
Shaft and winze sinking	73,200	7.6	29,900	6.9	103,000	7.4
Raising	147,000	15.2	2,950	.7	150,000	10.7
Drifting, crosscutting, tunneling	747,000	77.3	402,000	92.4	1,150,000	82.0
Total[1]	967,000	100.0	435,000	100.0	1,400,000	100.0
EXPLORATION						
Diamond drilling	1,700,000	8.9	169,000	24.3	1,870,000	9.4
Churn drilling	61,000	.3	--	--	61,000	.3
Rotary drilling	12,100,000	62.9	394,000	56.8	12,500,000	62.7
Percussion drilling	4,560,000	23.7	64,000	9.2	4,630,000	23.2
Other drilling	732,000	3.8	19,800	2.9	752,000	3.8
Trenching	85,600	.4	46,800	6.7	132,000	.7
Total[1]	19,200,000	100.0	693,000	100.0	19,900,000	100.0
Grand total[1]	20,200,000		1,130,000		21,300,000	

[1] Data may not add to totals shown because of independent rounding.
[2] Based on unrounded footage.

Table 14.—Exploration and development by method and selected metals and nonmetals, in 1974

(Feet)

Commodity	Development				Exploration						
	Shaft and winze sinking	Raising	Drifting, cross-cutting or tunneling	Total[1]	Diamond drilling	Churn drilling	Rotary drilling	Percussion drilling	Other drilling	Trenching	Total[1]
METALS											
Copper	4,380	61,100	106,000	172,000	846,000	4,410	166,000	62,100	8,290	2,670	1,090,000
Gold	3,410	9,950	49,100	62,400	187,000	2,710	79,200	3,830,000	400	74,400	4,120,000
Iron ore	390	801	55,300	56,500	133,000	1,130	6,500	17,800	300	--	159,000
Lead	950	11,700	68,000	80,700	140,000	52,300	11,100	15,200	77,400	--	296,000
Mercury	60	--	58	118	955	--	3,210	--	--	--	4,160
Silver	618	10,200	19,500	30,300	24,500	382	3,730	18,000	230	2,730	49,500
Tungsten	90	15,900	5,990	22,000	17,300	--	--	22,500	1,000	4,080	44,900
Uranium	59,100	18,100	266,000	343,000	93,400	--	11,800,000	470,000	644,000	--	13,000,000
Zinc	3,980	18,300	108,000	130,000	228,000	--	5,940	124,000	4,190	1,650	364,000
Other[2]	222	558	69,400	70,200	82,400	--	59,000	8,300	934	--	151,000
Total[1]	73,200	147,000	747,000	967,000	1,700,000	61,000	12,100,000	4,560,000	782,000	85,600	19,200,000
NONMETALS											
Barite	--	79	949	1,030	300	--	7,000	52,800	11,000	20,400	92,400
Fluorspar	100	1,720	8,130	9,950	134,000	--	--	2,000	--	200	137,000
Gypsum	--	--	--	--	320	--	--	--	--	--	320
Phosphate rock	--	224	6,690	6,910	2,620	--	295,000	--	6,900	300	305,000
Potassium salts	--	--	11,400	11,400	16,800	--	8,660	--	--	--	25,400
Sodium carbonate (natural)	--	--	373,000	373,000	325	--	23,400	--	--	--	23,700
Talc, soapstone, pyrophyllite	--	828	1,120	1,950	3,070	--	3,300	2,000	--	--	8,370
Other[3]	29,800	100	640	30,600	11,000	--	56,300	6,220	1,950	25,900	101,000
Total[1]	29,900	2,950	402,000	435,000	169,000	--	394,000	64,000	19,800	46,800	693,000
Grand total[1]	108,000	150,000	1,150,000	1,400,000	1,870,000	61,000	12,500,000	4,630,000	752,000	132,000	19,900,000

[1] Data may not add to totals shown because of independent rounding.

[2] Antimony, bauxite, beryllium, columbium and tantalum, manganiferous ore, molybdenum, nickel, tin, and titanium (ilmenite).

[3] Boron minerals, diatomite, kyanite, lithium minerals, magnesium compounds, mica (scrap), salt, stone (crushed and broken), stone (dimension), tripoli, and vermiculite.

Table 15.—Exploration and development by method and State, in 1974

(Feet)

State	Development				Exploration						
	Shaft and winze sinking	Raising	Drifting, cross-cutting, or tunneling	Total[1]	Diamond drilling	Churn drilling	Rotary drilling	Percussion drilling	Other drilling	Trenching	Total[1]
Alabama	--	--	--	--	--	--	--	--	--	--	--
Alaska	189	--	158	347	31,200	1,870	500	4,000	207	2,890	40,700
Arizona	4,540	59,400	94,600	158,000	435,000	4,510	131,000	25,300	20	6,000	602,000
Arkansas	--	79	949	1,030	--	--	22,500	--	--	--	22,500
California	1,076	16,200	7,280	24,600	56,000	--	71,700	12,000	3,060	2,800	146,000
Colorado	1,870	15,900	117,000	135,000	53,000	182	228,000	107,000	270	187	389,000
Florida	--	--	--	--	--	--	165,000	--	--	--	165,000
Georgia	--	--	--	--	4,990	--	6,000	--	--	--	11,000
Idaho	547	14,200	51,000	65,800	66,500	--	79,800	112	7,350	10,300	164,000
Illinois	--	1,560	7,730	9,290	134,000	--	--	--	--	--	134,000
Kentucky	25	160	300	485	--	--	--	--	--	--	--
Maine	--	--	1,840	1,840	43,400	--	--	--	--	--	43,400
Michigan	29,800	--	4,900	34,700	24,800	--	6,460	--	200	--	31,500
Minnesota	--	--	--	--	123,000	1,130	--	1,390	--	--	126,000
Missouri	390	1,290	76,800	78,400	125,000	52,300	--	16,400	88,400	7,900	290,000
Montana	1,250	544	8,180	9,970	43,100	--	505,000	6,940	200	3,810	559,000
Nevada	936	645	9,080	10,700	60,900	944	100,000	90,100	4,500	71,600	328,000
New Hampshire	--	--	--	--	2,100	--	--	--	--	--	2,100
New Mexico	1,300	13,700	249,000	264,000	203,000	--	2,690,000	340,000	634,000	20,400	3,880,000
New York	--	6,130	34,700	40,800	--	--	--	--	--	--	--
North Carolina	--	--	--	--	9,960	--	--	1,710	--	--	11,700
North Dakota	--	--	--	--	--	--	79,200	--	--	--	79,200
Oklahoma	--	--	--	--	--	--	--	--	--	5,600	5,600
Oregon	25	45	778	848	3,900	--	11,900	200	--	165	16,200
Pennsylvania	24	712	6,480	7,210	2,510	--	--	--	--	--	2,510
South Carolina	--	--	--	--	--	--	29,500	--	--	--	29,500
South Dakota	516	8,790	37,900	47,200	73,900	--	88,100	3,810,000	--	--	3,970,000
Tennessee	3,230	2,580	29,600	35,500	151,000	--	51,000	117,000	--	--	320,000
Texas	56,200	--	--	56,200	--	--	2,150,000	--	--	--	2,150,000
Utah	570	5,670	28,800	35,000	41,200	--	314,000	63,500	13,500	650	433,000
Virginia	--	1,300	1,440	2,740	31,900	--	--	--	--	--	31,900
Washington	--	751	5,770	6,520	52,800	--	4,150	16,200	--	--	73,200
Wisconsin	360	--	440	800	45,700	--	6,070	800	--	--	52,600
Wyoming	238	--	375,000	375,000	52,500	--	5,760,000	10,900	--	--	5,820,000
Total[1]	103,000	150,000	1,150,000	1,400,000	1,870,000	61,000	12,500,000	4,630,000	752,000	132,000	19,900,000

[1] Data may not add to totals shown because of independent rounding.

Table 16.—Total material (ore and waste) produced by mine development in the United States in 1974, by commodity and State

(Thousand short tons)

	Shaft and winze sinking	Raising	Drifting, crosscutting, or tunneling	Stripping	Total[1]
COMMODITY					
METALS					
Copper	52	135	1,000	162,000	163,000
Gold:					
Lode	18	36	150	1,390	1,590
Placer	5	(2)	(2)	211	216
Iron ore	4	11	1,130	13,600	14,800
Lead	7	52	1,870	2	1,930
Mercury	(2)	--	(2)	363	364
Silver	3	40	96	22	161
Tungsten	1	62	66	19	148
Uranium	18	59	922	45,400	46,400
Zinc	56	52	1,390	25	1,530
Other[3]	9	2	986	4,448	5,445
Total metals[1]	166	450	7,610	228,000	236,000
NONMETALS					
Barite	--	(2)	38	53	91
Fluorspar	(2)	9	78	(2)	88
Gypsum	--	--	--	9,620	9,620
Phosphate rock	--	8	231	8,140	8,380
Potassium salts	--	--	155	--	155
Sodium carbonate (natural)	--	--	3,160	--	3,160
Talc, soapstone, pyrophyllite	--	1	4	911	916
Other[4]	6,430	1	12	4,838	11,281
Total nonmetals[1]	6,430	19	3,680	23,500	33,600
Grand total[1]	6,590	469	11,300	251,000	270,000
STATE					
Alabama	--	--	--	W	W
Alaska	1	--	1	196	198
Arizona	50	115	879	158,000	159,000
Arkansas	--	(2)	38	229	267
California	5	68	67	4,930	5,070
Colorado	20	51	1,260	58	1,390
Georgia	--	--	--	W	W
Hawaii	--	--	--	W	W
Idaho	5	72	321	8,170	8,560
Illinois	--	9	74	--	83
Iowa	--	--	--	W	W
Kentucky	W	W	W	--	W
Maine	--	--	W	--	W
Michigan	6,430	--	116	1,930	8,480
Minnesota	--	--	--	10,800	10,800
Missouri	4	16	2,570	12	2,600
Montana	6	10	237	1,090	1,340
Nevada	5	3	47	7,210	7,260
New Mexico	9	42	940	417	1,410
New York	--	7	103	1,920	2,030
Oklahoma	--	--	--	1,520	1,520
Oregon	(2)	(2)	2	15	17
Pennsylvania	W	W	W	W	W
South Carolina	--	--	--	118	118
South Dakota	W	W	W	W	W
Tennessee	39	6	909	7	961
Texas	(2)	--	--	9,940	9,940
Utah	4	34	208	2,160	2,410
Virginia	--	W	W	W	W
Washington	--	3	103	718	820
Wisconsin	W	--	W	--	W
Wyoming	2	..	3,170	37,400	40,500
Undistributed	17	37	248	4,440	4,740
Total[1]	6,590	469	11,300	251,000	270,000

W Withheld to avoid disclosing individual company confidential data; included with "Undistributed."

[1] Data may not add to totals shown because of independent rounding.

[2] Less than ½ unit.

[3] Antimony, bauxite, beryllium, molybdenum, and vanadium.

[4] Abrasive stone, boron minerals, diatomite, garnet, kyanite, magnesite, magnesium compounds, mica (scrap), pumice, salt, tripoli, and vermiculite.

Table 17.—U.S. industrial consumption of explosives

(Thousand pounds)

Year	Coal mining	Metal mining	Quarrying and nonmetal mining	Total mineral industry	Other	Total industrial
1969	820,114	470,791	438,789	1,729,694	496,783	2,226,477
1970	962,331	479,507	455,424	1,897,263	496,228	2,393,491
1971	1,017,305	457,286	489,572	2,018,163	535,851	2,554,014
1972	1,212,585	430,686	493,677	2,136,948	535,841	2,669,789
1973	1,177,062	495,879	643,292	2,316,233	438,713	2,754,946
1974	1,186,614	465,490	551,380	2,203,484	558,806	2,762,290

Table 18.—U.S. consumption of explosives in the minerals industry

(Thousand pounds)

Year	Coal mining	Metal mining	Quarrying and nonmetal mining	Total
PERMISSIBLE EXPLOSIVES				
1972	42,232	99	865	43,196
1973	39,307	115	957	40,379
1974	38,332	192	1,237	39,761
OTHER HIGH EXPLOSIVES				
1972	16,297	27,648	100,600	144,545
1973	20,198	28,295	107,675	156,168
1974	26,301	27,733	99,364	153,398
CYLINDRICALLY PACKED BLASTING AGENTS				
1972	201,820	7,542	30,064	239,426
1973	222,797	6,265	32,228	261,290
1974	249,843	5,414	32,797	288,054
PACKAGED AND BULK WATER GELS AND SLURRIES				
1972	9,212	156,618	41,305	207,135
1973	11,622	173,530	54,154	239,306
1974	22,204	160,198	75,837	258,239
OTHER PROCESSED BLASTING AGENTS AND UNPROCESSED AMMONIUM NITRATE				
1972	943,024	238,779	320,843	1,502,646
1973	883,138	287,674	448,278	1,619,090
1974	849,934	271,953	342,145	1,464,032
TOTAL EXPLOSIVES				
1972	1,212,585	430,686	493,677	2,136,948
1973	1,177,062	495,879	643,292	2,316,233
1974	1,186,614	465,490	551,380	2,203,484

Statistical Summary

By Staff, Office of Technical Data Services

This chapter summarizes data on crude mineral production for the United States, its island possessions, and the Commonwealth of Puerto Rico. Included also are tables that show the principal mineral commodities exported from and imported into the United States, and that compare world and U.S. mineral production. The detailed data from which these tables were derived are contained in the individual commodity chapters of volume I and in the State chapters of volume II of this edition of the Minerals Yearbook.

Although crude mineral production may be measured at any of several stages of extraction and processing, the stage of measurement used in this chapter is what is normally termed "mine output." It usually refers to minerals or ores in the form in which they are first extracted from the ground, but customarily includes the product of auxiliary processing at or near the mines.

Because of inadequacies in the statistics available, some series deviate from the foregoing definition. In the cases of gold, silver, copper, lead, zinc and tin, the quantities are recorded on a mine basis (as the recoverable content of ore sold or treated). However the values assigned to these quantities are based on the average selling price of refined metal, not on the mine value. Mercury is measured as recovered metal and valued at the average New York price for the metal.

The weight or volume units shown are those customarily used in the particular industries producing the commodities. Values shown are in current dollars, with no adjustment made to compensate for changes in the purchasing power of the dollar.

Table 1.—Value of crude mineral production [1] in the United States, by mineral group
(Million dollars)

Year	Mineral fuels	Nonmetals except fuels	Metals	Total [2]
1970	20,152	5,712	3,928	29,792
1971	21,247	6,058	[r] 3,406	[r] 30,711
1972	22,061	6,482	3,642	32,185
1973	25,012	7,418	4,362	[r] 36,787
1974	40,937	8,682	5,552	55,172

[r] Revised.

[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

[2] Data may not add to totals shown because of independent rounding.

Table 2.—Mineral production [1] in the United States

Mineral	1971		1972		1973		1974	
	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)
MINERAL FUELS								
Asphalt and related bitumens, native: Bituminous limestone, sandstone, gilsonite short tons	1,668,928	$8,291	1,995,374	$10,303	2,088,657	$8,464	2,021,165	$16,666
Carbon dioxide, natural thousand cubic feet	1,271,995	216	1,228,741	165	1,134,986	259	966,118	237
Coal:								
Bituminous and lignite [2] thousand short tons	552,192	3,901,496	595,386	4,561,983	591,738	5,049,612	603,406	9,502,347
Pennsylvania anthracite do	8,727	103,469	7,106	85,251	6,830	90,260	6,617	144,695
Helium:								
Crude million cubic feet	3,988	47,856	3,467	41,604	2,558	30,696	184	2,208
High-purity do	577	14,539	629	15,673	647	16,121	699	18,105
Natural gas do	22,493,012	4,085,482	22,531,698	4,180,462	22,647,549	4,894,072	21,600,522	6,573,402
Natural gas liquids:								
Natural gasoline and cycle products thousand 42-gallon barrels	200,181	616,657	193,480	604,423	187,390	668,784	168,152	1,107,158
LPG do	417,634	769,397	444,736	847,810	447,033	1,188,289	447,946	1,980,769
Peat thousand short tons	600	7,011	607	7,112	621	7,547	706	10,989
Petroleum (crude) thousand 42-gallon barrels	3,453,914	11,692,998	3,455,368	11,706,510	3,360,903	13,057,905	3,202,585	21,580,549
Total mineral fuels	XX	21,247,000	XX	22,061,000	XX	25,012,000	XX	40,937,000
NONMETALS (EXCEPT FUELS)								
Abrasive stones [3] short tons	2,349	563	3,241	670	3,466	667	3,134	717
Asbestos do	130,882	12,174	131,663	13,408	150,036	16,288	109,091	13,393
Barite thousand short tons	825	13,491	906	14,883	1,104	16,688	1,106	16,822
Boron minerals do	1,047	89,856	1,121	95,882	1,225	113,648	1,185	128,306
Bromine thousand pounds	355,946	61,750	386,864	63,689	418,250	67,131	432,094	117,715
Calcium-magnesium chloride short tons	W	W	W	W	609,300	17,581	867,100	29,189
Cement:								
Portland thousand short tons	75,881	1,421,388	77,973	1,588,290	82,718	1,810,292	75,983	1,992,695
Masonry do	3,341	84,556	3,777	100,269	4,057	119,547	3,371	111,106
Clays do	56,666	274,431	59,456	303,022	64,351	354,058	60,796	422,542
Diatomite short tons	535,318	34,392	576,089	37,554	608,906	36,083	664,303	50,693
Emery do	W	W	2,883	W	2,884	W	W	W
Feldspar do	742,810	9,969	746,212	10,623	791,900	12,830	853,702	14,482
Fluorspar do	272,071	17,263	250,347	17,315	248,601	r 17,381	201,116	14,297
Garnet (abrasive) do	18,984	1,934	18,916	1,957	22,772	2,381	24,684	2,550
Gem stones [4]	NA	2,589	NA	2,728	NA	2,739	NA	4,583
Gypsum thousand short tons	10,418	39,057	12,328	48,504	13,558	56,650	11,999	52,894
Lime do	19,591	308,100	20,290	339,304	21,090	365,849	21,606	473,685
Magnesium compounds from seawater and brine (except for metal) short tons, MgO equivalent	668,649	62,322	729,472	63,915	853,907	77,733	907,492	96,742

Mica:								
Scrap ________ thousand short tons __	127	2,917	160	4,353	177	6,082	187	5,475
Sheet ________ pounds __	17,005	7	14,280	7	--	--	15,000	15
Perlite ________ short tons __	432,208	4,041	544,594	6,231	543,683	5,591	555,000	7,024
Phosphate rock ________ thousand short tons __	88,886	203,828	40,881	207,910	42,137	238,667	45,686	501,429
Potassium salts thousand short tons, K₂O equivalent __	2,587	100,527	2,659	106,680	2,603	112,613	2,552	158,974
Pumice ________ thousand short tons __	3,391	5,214	3,813	6,539	[r] 3,937	[r] 8,881	3,937	9,121
Pyrites ________ thousand long tons __	808	7,137	741	6,652	559	4,961	424	4,238
Salt ________ thousand short tons __	44,077	303,687	45,022	296,772	43,910	306,103	46,536	360,763
Sand and gravel ________ do ____	919,593	1,148,969	914,324	1,200,701	983,629	1,359,370	978,754	1,451,071
Sodium carbonate (natural) ________ do ____	2,878	60,774	3,218	71,689	3,722	94,385	4,059	137,486
Sodium sulfate (natural) ________ do ____	688	11,008	701	11,396	672	11,597	684	16,411
Stone [4] ________ do ____	876,128	1,594,065	920,423	1,672,298	1,060,124	1,990,463	1,043,542	2,186,155
Sulfur, Frasch process ________ thousand long tons __	6,738	117,894	7,618	182,385	7,438	138,578	7,898	241,066
Talc, soapstone, pyrophyllite ________ short tons __	1,037,297	7,634	1,107,404	7,828	1,246,534	9,144	1,267,633	11,099
Tripoli ________ do ____	75,134	569	87,864	797	101,519	930	86,000	3,665
Vermiculite ________ thousand short tons __	301	7,198	337	8,092	365	9,464	341	10,120
Value of items that cannot be disclosed: Aplite, brucite (1971), natural and slag cement, graphite, iodine, kyanite, lithium minerals, magnesite, greensand marl, olivine, staurolite, wollastonite, and values of nonmetal items indicated by symbol W ____	XX	47,358	XX	39,730	XX	28,926	XX	35,763
Total nonmetals ________	XX	6,058,000	XX	6,482,000	XX	7,413,000	XX	8,682,000
METALS								
Antimony ore and concentrate short tons, antimony content __	1,025	938	489	386	545	688	661	2,040
Bauxite ______ thousand long tons, dried equivalent __	1,988	28,543	1,812	23,238	1,879	26,635	1,949	25,663
Copper (recoverable content of ores, etc.) short tons __	1,522,188	1,583,071	1,664,840	1,704,796	1,717,940	2,044,346	1,597,002	2,468,964
Gold (recoverable content of ores, etc.) troy ounces __	1,495,108	61,673	1,449,943	84,967	1,175,750	115,000	1,126,886	180,009
Iron ore, usable (excluding byproduct iron sinter) thousand long tons, gross weight __	77,106	891,002	77,884	950,365	90,654	1,163,710	84,985	1,388,447
Lead (recoverable content of ores, etc.) short tons __	578,550	159,679	618,915	186,046	603,024	196,465	663,870	298,742
Manganese ore (35% or more Mn) short tons, gross weight __	142	W	578	W	239	W	--	--
Manganiferous ore (5% to 35% Mn) ________ do ____	198,334	W	147,161	W	203,055	W	272,908	2,323
Mercury ________ 76-pound flasks __	17,883	5,229	7,333	1,601	2,171	621	2,189	617
Molybdenum (content of concentrate) thousand pounds __	97,882	164,917	102,197	170,530	185,097	217,701	118,163	234,658
Nickel (content of ore and concentrate) short tons __	17,036	W	16,864	W	18,272	W	16,618	W
Rare-earth metal concentrates ________ do ____	17,194	7,538	19,520	8,479	31,278	13,780	35,218	15,966
Silver (recoverable content of ores, etc.) thousand troy ounces __	41,564	64,258	37,233	62,737	37,827	96,762	33,762	159,018
Tin ________ long tons __	W	W	W	W	W	W	139	1,056

See footnotes at end of table.

Table 2.—Mineral production[1] in the United States—Continued

Mineral	1971		1972		1973		1974	
	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)
METALS—Continued								
Titanium concentrate:								
Ilmenite .... short tons, gross weight ..	713,610	$15,936	739,801	$16,739	804,355	$19,829	755,299	$22,715
Rutile .... do	W	W	W	W	9,045	1,212	6,446	996
Tungsten ore and concentrate thousand pounds contained W ..	6,827	20,184	7,045	18,104	7,059	19,154	7,836	37,413
Uranium (recoverable content U_3O_8) thousand pounds ..	24,515	151,996	25,758	162,272	[r] 25,803	[r] 167,718	23,227	243,884
Vanadium (recoverable in ore and concentrate, short tons ..	5,252	37,690	4,887	30,867	4,377	26,611	4,870	38,266
Zinc (recoverable content of ores, etc.) ...... do	[r] 502,543	[r] 161,820	478,318	169,803	478,850	197,861	499,872	358,908
Value of items that cannot be disclosed: Beryllium, cobalt (1971), magnesium chloride for magnesium metal, manganiferous residuum, platinum-group metals (crude), zircon concentrate, and values of metal items indicated by symbol W	XX	51,690	XX	50,650	XX	[r] 54,004	XX	72,772
Total metals	XX	[r] 3,406,000	XX	3,642,000	XX	4,362,000	XX	5,552,000
Grand total	XX	[r] 30,711,000	XX	32,185,000	XX	[r] 36,787,000	XX	55,172,000

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[e] Estimate. [r] Revised. NA Not available. XX Not applicable. W Withheld to avoid disclosing individual company confidential data; included with "Value of items that cannot be disclosed."

[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

[2] Includes a small quantity of anthracite mined in States other than Pennsylvania. In 1971, value excluded that of Arizona, which is withheld to avoid disclosing individual company confidential data; value included with "Nonmetal items that cannot be disclosed."

[3] Grindstones, pulpstones, grinding pebbles, sharpening stones, and tube mill liners.

[4] Excludes abrasive stone, bituminous limestone, bituminous sandstone, and soapstone, all included elsewhere in table.

Table 3.—Minerals produced in the United States and principal producing States in 1974

Mineral	Principal producing States, in order of quantity	Other producing States
Antimony ore and concentrate	Idaho, Mont., Nev.	
Aplite	Va.	
Asbestos	Calif., Vt., Ariz., N.C.	
Asphalt (native)	Tex., Utah, Ala., Mo.	
Barite	Nev., Mo., Ga., Ark	Alaska, Calif., Idaho, Ill., Tenn.
Bauxite	Ark., Ala., Ga.	
Beryllium concentrate	Utah.	
Boron minerals	Calif.	
Bromine	Ark., Mich., Calif.	
Calcium-magnesium chloride	Mich. and Calif.	
Carbon dioxide (natural)	N. Mex., Calif., Colo., Utah.	
Cement	Calif., Tex., Pa., Mich	Ala., Ariz., Ark., Colo., Fla., Ga., Hawaii, Idaho, Ill., Ind., Iowa, Kans., Ky., La., Maine, Md., Minn., Miss., Mo., Mont., Nebr., Nev., N. Mex., N.Y., N.C., Ohio, Okla., Oreg., S.C., S. Dak., Tenn., Utah, Va., Wash., W. Va., Wis., Wyo.
Clays	Ga., Tex., Ohio, N.C	All other States except Alaska, R.I., Vt.
Coal	Ky., W. Va., Pa., Ill	Ala., Alaska, Ariz., Ark., Colo., Ind., Iowa, Kans., Md., Mo., Mont., N. Mex., N. Dak., Ohio, Okla., Tenn., Tex., Utah, Va., Wash., Wyo.
Copper (mine)	Ariz., Utah, N. Mex., Mont	Alaska, Calif., Colo., Idaho, Ill., Maine, Mich., Mo., Nev., Okla., Oreg., Tenn., Wash., Wis.
Diatomite	Calif., Nev., Wash	Kans. and Oreg.
Emery	N.Y.	
Feldspar	N.C., Conn., Ga., Calif	Ariz., Colo., Okla., S. Dak., Wyo.
Fluorspar	Ill., Mont., Tex., Nev	Colo., Ky., N. Mex., Utah.
Garnet, abrasive	Idaho and N.Y.	
Gold (mine)	S. Dak., Nev., Utah, Ariz	Alaska, Calif., Colo., Idaho, Mont., N. Mex., Oreg., Tenn., Wash.
Graphite	Tex.	
Gypsum	Calif., Mich., Tex., Iowa	Ariz., Ark., Colo., Idaho, Ind., Kans., La., Mont., Nev., N. Mex., N.Y., Ohio, Okla., S. Dak., Utah, Va., Wash., Wyo.
Helium	Kans., Tex., Okla., Ariz.	
Iodine	Mich.	
Iron ore	Minn., Mich., Calif., Wyo	Ala., Ariz., Ark., Colo., Ga., Idaho, Mo., Mont., Nev., N. Mex., N.Y., N.C., Pa., S. Dak., Tex., Utah, Wis.
Kyanite	Va., Ga., Fla.	
Lead (mine)	Mo., Idaho, Colo., Utah	Ariz., Calif., Ill., Maine, Mont., Nev., N. Mex., N.Y., Okla., Oreg., Wash., Wis.
Lime	Ohio, Pa., Mo., Tex	Ala., Ariz., Ark., Calif., Colo., Conn., Fla., Hawaii, Idaho, Ill., Ind., Iowa, Kans., Ky., La., Md., Mass., Mich., Minn., Miss., Mont., Nebr., Nev., N. Mex., N.Y., N. Dak., Okla., Oreg., S. Dak., Tenn., Utah, Va., Wash., W. Va., Wis., Wyo.
Lithium minerals	N.C., Nev., Calif.	
Magnesite	Nev.	
Magnesium chloride	Tex.	
Magnesium compounds	Mich., Calif., N.J., Fla	Del., Miss., Tex., Utah.
Manganiferous ore	Minn. and N. Mex.	
Manganiferous residuum	N.J.	
Marl, greensand	N.J.	
Mercury	Calif., N.Y., Nev., Alaska.	
Mica, scrap	N.C., Ala., Ga., S.C	Ariz., Conn., N. Mex., S. Dak.
Molybdenum	Colo., Ariz., N. Mex., Utah	Calif. and Nev.
Natural gas	Tex., La., Okla., N. Mex	Ala., Alaska, Ariz., Ark., Calif., Colo., Fla., Ill., Ind., Kans., Ky., Md., Mich., Miss., Mo., Mont., Nebr., N.Y., N. Dak., Ohio, Pa., Tenn., Utah, Va., W. Va., Wyo.
Natural gas liquids	Tex., La., Okla., N. Mex	Ala., Alaska, Ark., Calif., Colo., Fla., Ill., Kans., Ky., Mich., Miss., Mont., Nebr., N. Dak., Pa., S. Dak., Utah, W. Va., Wyo.
Nickel	Oreg.	
Olivine	Wash. and N.C.	

Table 3.—Minerals produced in the United States and principal producing States in 1974—Continued

Mineral	Principal producing States, in order of quantity	Other producing States
Peat	Mich., Ill., Ind., Fla	Calif., Colo., Ga., Iowa, Maine, Md., Mass., Minn., Mont., N.J., N. Mex., N.Y., N. Dak., Ohio, Pa., S.C., Vt., Wash., Wis.
Perlite	N. Mex., Ariz., Calif., Nev	Colo. and Idaho.
Petroleum, crude	Tex., La., Calif., Okla	Ala., Alaska, Ariz., Ark., Colo., Fla., Ill., Ind., Kans., Ky., Mich., Miss., Mo., Mont., Nebr., Nev., N. Mex., N.Y., N. Dak., Ohio, Pa., S. Dak., Tenn., Utah, Va., W. Va., Wyo.
Phosphate rock	Fla., Idaho, Tenn., N.C	Mo., Mont., Utah, Wyo.
Platinum-group metals	Alaska.	
Potassium salts	N. Mex., Utah, Calif.	
Pumice	Oreg., Calif., Ariz., N. Mex	Colo., Hawaii, Idaho, Kans., Nev., Okla., Utah, Wash.
Pyrites ore and concentrate	Tenn., Colo., Ariz.	
Rare-earth metal concentrate	Calif., Ga., Fla.	
Salt	La., Tex., N.Y., Ohio	Ala., Calif., Colo., Kans., Mich., Nev., N. Mex., N. Dak., Okla., Utah, W. Va.
Sand and gravel	Alaska, Calif., Mich., Ill., Tex	All other States.
Silver (mine)	Idaho, Ariz., Mont., Utah	Alaska, Calif., Colo., Ill., Maine, Mich., Mo., Nev., N. Mex., N.Y., Okla., Oreg., S. Dak., Tenn., Wash., Wis.
Sodium carbonate (natural)	Wyo. and Calif.	
Sodium sulfate (natural)	Calif., Colo., Nev	
Staurolite	Fla.	
Stone	Pa., Ill., Tex., Fla	All other States except Del.
Sulfur (Frasch)	Tex. and La.	
Talc, soapstone, pyrophyllite	N.Y., Mont., Vt., Tex	Ala., Ark., Calif., Ga., Md., Nev., N.C., Oreg., Pa., Va., Wash.
Tin	Colo., N. Mex., Alaska.	
Titanium concentrate	N.Y., Fla., N.J., Ga.	
Tripoli	Ill., Okla., Ark., Pa.	
Tungsten concentrate	Calif., Colo., Nev	Ariz., Idaho, Mont., Utah, Wash.
Uranium	N. Mex., Wyo., Colo., Utah	Tex. and Wash.
Vanadium	Ark., Colo., Idaho, Utah	N. Mex.
Vermiculite	Mont. and S.C.	
Wollastonite	N.Y.	
Zinc (mine)	N.Y., Mo., Tenn., Colo	Ariz., Calif., Idaho, Ill., Maine, Mont., Nev., N.J., N. Mex., Okla., Oreg., Pa., Utah, Va., Wash., Wis.
Zircon concentrate	Fla. and Ga.	

Table 4.—Value of mineral production in the United States and principal minerals produced in 1974

State	Value (thousands)	Rank	Percentage of U.S. total	Principal minerals, in order of value
Alabama	$764,746	19	1.39	Coal, petroleum, cement, stone.
Alaska	448,437	23	.81	Petroleum, sand and gravel, natural gas, stone.
Arizona	1,562,234	9	2.83	Copper, molybdenum, sand and gravel, cement.
Arkansas	406,821	26	.74	Petroleum, bromine, stone, natural gas.
California	2,797,080	3	5.07	Petroleum, cement, sand and gravel, natural gas.
Colorado	750,299	20	1.36	Petroleum, perlite, coal, sand and gravel.
Connecticut	35,362	47	.06	Stone, sand and gravel, feldspar, lime.
Delaware	[1] 3,798	50	([2])	Sand and gravel, magnesium compounds, clays, gem stones.
Florida	1,043,895	14	1.89	Phosphate rock, petroleum, stone, cement.
Georgia	363,100	29	.66	Clays, stone, cement, sand and gravel.
Hawaii	42,042	44	.08	Stone, cement, sand and gravel, pumice.
Idaho	208,558	31	.38	Silver, phosphate rock, zinc, sand and gravel.
Illinois	1,149,210	11	2.08	Coal, petroleum, stone, sand and gravel.
Indiana	440,690	24	.80	Coal, cement, stone, petroleum.
Iowa	176,720	32	.32	Cement, stone, sand and gravel, gypsum.
Kansas	889,398	18	1.61	Petroleum, natural gas, natural gas liquids, cement.
Kentucky	2,563,210	4	4.65	Coal, stone, petroleum, natural gas.
Louisiana	8,146,578	2	14.77	Petroleum, natural gas, natural gas liquids, sulfur.
Maine	36,348	45	.07	Cement, sand and gravel, zinc, stone.
Maryland	172,880	33	.31	Coal, stone, cement, sand and gravel.
Massachusetts	62,109	43	.11	Stone, sand and gravel, lime, clays.
Michigan	1,040,067	15	1.89	Iron ore, petroleum, cement, copper.
Minnesota	1,026,366	16	1.86	Iron ore, sand and gravel, stone, cement.
Mississippi	391,155	28	.71	Petroleum, natural gas, sand and gravel, cement.
Missouri	691,049	21	1.25	Lead, cement, stone, zinc.
Montana	574,801	22	1.04	Petroleum, copper, coal, cement.
Nebraska	98,634	42	.18	Petroleum, cement, sand and gravel, stone.
Nevada	257,876	30	.47	Copper, gold, sand and gravel, diatomite.
New Hampshire	13,691	48	.02	Sand and gravel, stone, clays, gem stones.
New Jersey	140,748	37	.26	Stone, sand and gravel, zinc, magnesium compounds.
New Mexico	1,941,544	8	3.52	Petroleum, natural gas, copper, natural gas liquids.
New York	440,573	25	.80	Cement, stone, zinc, salt.
North Carolina	155,869	35	.28	Stone, sand and gravel, cement, feldspar.
North Dakota	159,427	34	.29	Petroleum, coal, natural gas liquids, sand and gravel.
Ohio	1,107,670	12	2.01	Coal, stone, lime, cement.
Oklahoma	2,123,690	7	3.85	Petroleum, natural gas, natural gas liquids, cement.
Oregon	103,920	40	.19	Stone, sand and gravel, cement, nickel.
Pennsylvania	2,374,512	6	4.30	Coal, cement, stone, lime.
Rhode Island	5,982	49	.01	Stone, sand and gravel, gem stones.
South Carolina	105,171	39	.19	Cement, stone, clays, sand and gravel.
South Dakota	102,627	41	.19	Gold, cement, stone, sand and gravel.
Tennessee	395,608	27	.71	Coal, stone, zinc, cement.
Texas	13,711,144	1	24.85	Petroleum, natural gas, natural gas liquids, cement.
Utah	952,045	17	1.72	Copper, petroleum, coal, gold.
Vermont	35,453	46	.06	Stone, asbestos, sand and gravel, talc.
Virginia	1,058,207	13	1.92	Coal, stone, cement, sand and gravel.
Washington	143,916	36	.26	Cement, sand and gravel, stone, coal.
West Virginia	2,403,177	5	4.36	Coal, natural gas, stone, cement.
Wisconsin	114,763	38	.21	Stone, sand and gravel, iron ore, cement.
Wyoming	1,437,200	10	2.60	Petroleum, sodium compounds, coal, uranium.
Total	55,172,000	--	100.0	

[1] Incomplete total.
[2] Less than ½ percent.

Table 5.—Value of mineral production per capita and per square mile in 1974, by State

State	Area (square miles)	1970 population (thousands)	Value of mineral production				
			Total (thousands)	Per square mile		Per capita	
				Dollars	Rank	Dollars	Rank
Alabama	51,609	3,444	$764,746	$14,818	16	$222	19
Alaska	586,412	300	448,437	765	50	1,495	4
Arizona	113,909	1,771	1,562,234	13,715	18	882	8
Arkansas	53,104	1,923	406,821	7,660	27	212	20
California	158,693	19,953	2,797,080	17,626	13	140	26
Colorado	104,247	2,207	750,299	7,197	29	340	14
Connecticut	5,009	3,032	35,362	7,060	30	12	47
Delaware	2,057	548	[1]3,793	1,844	44	7	49
Florida	58,560	6,789	1,043,895	17,526	12	154	23
Georgia	58,876	4,590	363,100	6,167	32	79	33
Hawaii	6,450	769	42,042	6,518	31	55	36
Idaho	83,557	718	208,558	2,496	39	298	15
Illinois	56,400	11,114	1,149,210	20,376	9	103	29
Indiana	36,291	5,194	440,690	12,143	20	85	31
Iowa	56,290	2,824	176,720	3,139	37	63	35
Kansas	82,264	2,247	889,398	10,812	22	396	13
Kentucky	40,395	3,219	2,563,210	63,454	3	796	11
Louisiana	48,523	3,641	8,146,578	167,891	1	2,237	2
Maine	33,215	992	36,348	1,094	48	37	41
Maryland	10,577	3,922	172,880	16,345	14	44	38
Massachusetts	8,257	5,689	62,109	7,522	28	11	48
Michigan	58,216	8,875	1,040,067	17,866	11	117	27
Minnesota	84,068	3,805	1,026,366	12,209	19	270	16
Mississippi	47,716	2,217	391,155	8,198	26	176	22
Missouri	69,686	4,677	691,049	9,916	23	148	25
Montana	147,138	694	574,801	3,907	34	828	10
Nebraska	77,227	1,483	98,634	1,217	47	67	34
Nevada	110,540	489	257,876	2,333	40	527	12
New Hampshire	9,304	738	13,691	1,472	45	19	46
New Jersey	7,836	7,168	140,748	17,962	10	20	45
New Mexico	121,666	1,016	1,941,544	15,958	15	1,911	3
New York	49,576	18,237	440,573	8,887	25	24	44
North Carolina	52,586	5,082	155,869	2,964	38	31	42
North Dakota	70,665	618	159,427	2,256	41	258	17
Ohio	41,222	10,652	1,107,670	26,871	7	104	28
Oklahoma	69,919	2,559	2,123,690	30,374	6	830	9
Oregon	96,981	2,091	103,920	1,072	49	50	37
Pennsylvania	45,333	11,794	2,374,512	52,379	4	201	21
Rhode Island	1,214	947	5,982	4,928	33	6	50
South Carolina	31,055	2,591	105,171	3,387	36	41	40
South Dakota	77,047	666	102,627	1,332	46	154	24
Tennessee	42,244	3,924	395,608	9,365	24	101	30
Texas	267,338	11,197	13,711,144	51,288	5	1,225	6
Utah	84,916	1,059	952,045	11,212	21	899	7
Vermont	9,609	444	35,453	3,690	35	80	32
Virginia	40,817	4,648	1,058,207	25,926	8	228	18
Washington	68,192	3,409	143,916	2,110	42	42	39
West Virginia	24,181	1,744	2,403,177	99,383	2	1,378	5
Wisconsin	56,154	4,418	114,763	2,044	43	26	43
Wyoming	97,914	332	1,437,200	14,678	17	4,329	1
Total	3,615,055	202,455	55,172,000	15,262	--	273	--

[1] Incomplete total.

Table 6.—Mineral production [1] in the United States, by State

Mineral	1971		1972		1973		1974	
	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)
ALABAMA								
Cement: [2]								
Masonry thousand short tons	349	$8,657	407	$11,221	425	$13,074	314	$11,322
Portland do	2,284	42,281	2,360	48,577	2,396	55,820	2,190	61,990
Clays [3] do	2,915	6,913	2,850	7,512	2,934	8,788	2,995	13,298
Coal (bituminous) do	17,944	146,180	20,814	200,430	19,230	211,695	19,824	432,036
Iron ore (usable) thousand long tons, gross weight	415	2,773	327	1,912	271	1,408	W	W
Lime thousand short tons	761	11,454	739	11,751	881	14,050	1,054	22,346
Natural gas million cubic feet	355	54	3,644	1,282	11,271	4,307	27,865	20,704
Petroleum (crude) thousand 42-gallon barrels	7,832	23,496	9,934	30,466	11,677	41,772	13,323	113,808
Sand and gravel thousand short tons	6,674	7,513	6,352	8,530	9,805	13,870	12,454	19,120
Stone [4] do	17,773	34,413	18,485	42,027	20,043	40,117	23,773	60,231
Value of items that cannot be disclosed: Asphalt (native), bauxite, cement (slag, 1971–73), clays (bentonite), mica (scrap), natural gas liquids, salt, stone (dimension), talc, and values indicated by symbol W	XX	7,758	XX	7,533	XX	8,155	XX	9,891
Total	XX	291,492	XX	371,241	XX	413,056	XX	764,746
ALASKA								
Barite thousand short tons	102	1,075	W	W	W	W	20	401
Coal (bituminous) do	698	5,710	668	W	694	W	700	W
Gem stones	NA	W	NA	57	NA	57	NA	57
Gold (recoverable content of ores, etc.) troy ounces	13,012	537	8,639	506	7,107	695	9,146	1,461
Lead (recoverable content of ores, etc.) short tons	--	--	--	--	6	2	--	--
Natural gas million cubic feet	121,618	17,878	125,596	18,463	131,007	19,483	128,935	21,919
Petroleum (crude) thousand 42-gallon barrels	79,494	257,562	72,893	235,444	72,323	261,877	70,603	347,408
Sand and gravel thousand short tons	23,617	32,806	14,187	15,214	14,999	19,913	117,752	52,788
Silver (recoverable content of ores, etc.) thousand troy ounces	1	1	(5)	(5)	1	2	1	3
Stone thousand short tons	2,658	5,066	652	3,012	5,967	12,741	5,484	12,947
Tin long tons	17	47	W	W	5	12	W	W
Value of items that cannot be disclosed: Copper (1974), mercury, natural gas liquids, platinum-group metals, uranium (1971–73), and values indicated by symbol W	XX	2,141	XX	13,442	XX	r 14,156	XX	11,453
Total	XX	322,823	XX	286,138	XX	r 328,938	XX	448,437
ARIZONA								
Clays thousand short tons	[3] 119	[3] 84	[3] 134	[3] 355	[3] 117	[3] 459	199	622
Coal (bituminous) do	1,146	W	W	W	3,247	W	6,448	W
Copper short tons	820,171	852,978	908,612	930,419	927,271	1,103,453	858,783	1,327,678
Gem stones	NA	160	NA	168	NA	170	NA	1,500
Gold (recoverable content of ores, etc.) troy ounces	94,038	3,879	102,996	6,036	102,848	10,060	90,586	14,470

See footnotes at end of table.

Table 6.—Mineral production[1] in the United States, by State—Continued

Mineral	1971 Quantity	1971 Value (thousands)	1972 Quantity	1972 Value (thousands)	1973 Quantity	1973 Value (thousands)	1974 Quantity	1974 Value (thousands)
ARIZONA—Continued								
Gypsum ---------- thousand short tons --	W	W	W	W	158	$669	141	$473
Helium, high-purity ---------- million cubic feet --	W	W	W	W	W	W	W	W
Iron ore (usable) - thousand long tons, gross weight --	16	W	W	W	W	W	W	W
Lead (recoverable content of ores, etc.) -- short tons --	859	$237	1,763	$530	763	248	1,059	476
Lime ---------- thousand short tons --	296	4,474	356	6,024	365	7,019	422	9,071
Mica (scrap) ---------- do ----	W	W	W	W	W	W	2	82
Molybdenum (content of concentrate) thousand pounds --	22,684	39,872	27,216	46,791	27,657	59,272	28,848	57,067
Natural gas (marketed) ---------- million cubic feet --	868	153	442	80	125	23	224	45
Petroleum (crude) ------- thousand 42-gallon barrels --	1,236	3,918	993	3,226	804	3,103	740	3,885
Pumice ---------- thousand short tons --	949	625	915	722	853	715	846	865
Sand and gravel ---------- do ----	19,791	24,391	24,842	32,420	27,440	38,503	23,417	41,906
Silver (recoverable content of ores, etc.) thousand troy ounces --	6,170	9,538	6,653	11,210	7,199	18,416	6,356	29,935
Stone ---------- thousand short tons --	2,873	5,848	4,638	8,018	4,265	9,469	4,932	11,479
Zinc (recoverable content of ores, etc.) --- short tons --	7,761	2,499	10,111	3,589	8,427	3,482	9,699	6,964
Value of items that cannot be disclosed: Asbestos, cement, clays (fire, 1971–73, bentonite), diatomite (1971–72), feldspar, fluorspar (1971–73), perlite, pyrites, tungsten, and values indicated by symbol W ----------	XX	32,364	XX	41,416	XX	49,827	XX	55,716
Total ----------	XX	981,020	XX	1,091,004	XX	1,304,988	XX	1,562,234
ARKANSAS								
Bauxite -------- thousand long tons, dried equivalent --	1,781	24,979	1,634	21,010	1,686	23,884	1,731	23,597
Clays ---------- thousand short tons --	[3]936	[3]1,499	[3]885	[3]990	[3]1,446	[3]1,412	984	1,597
Coal (bituminous) ---------- do ----	276	2,848	428	4,676	434	5,806	455	9,673
Gem stones ----------	NA	30	NA	32	NA	50	NA	60
Iron ore ---------- thousand long tons, gross weight --	—	—	—	—	W	W	4	W
Lime ---------- thousand short tons --	157	2,313	150	2,456	177	2,742	187	3,189
Natural gas ---------- million cubic feet --	172,154	29,426	166,522	28,808	157,529	28,985	123,975	32,234
Natural gas liquids:								
Natural gasoline and cycle products thousand 42-gallon barrels --	517	1,686	261	854	204	861	199	1,344
LP gases ---------- do ----	1,035	2,650	546	1,420	449	1,688	418	2,491
Petroleum (crude) ---------- do ----	18,263	56,805	18,519	58,335	18,016	70,618	16,527	122,817
Sand and gravel ---------- thousand short tons --	11,630	15,603	11,574	16,558	12,465	20,625	14,878	29,922
Stone ---------- do ----	17,647	28,776	16,317	25,020	16,223	26,209	20,381	38,905
Value of items that cannot be disclosed: Abrasive stones, barite, bromine, cement, clays (kaolin, 1971–73), gypsum, mercury (1971), soapstone, tripoli, vanadium, and values indicated by symbol W ----------	XX	79,703	XX	81,020	XX	90,825	XX	140,992
Total ----------	XX	246,818	XX	241,179	XX	273,705	XX	406,821

CALIFORNIA								
Asbestos short tons	87,144	7,806	90,967	8,673	105,663	10,886	58,331	5,697
Barite thousand short tons	W	W	4	34	11	152	4	W
Boron minerals do	1,047	89,856	1,121	95,882	1,225	113,648	1,185	128,306
Cement do	9,117	169,921	9,086	182,308	9,395	201,892	8,264	210,520
Clays do	[3]2,822	[3]7,103	2,706	7,387	2,723	6,853	2,497	7,626
Copper (recoverable content of ores, etc.) short tons	515	536	598	612	369	440	194	300
Gem stones	NA	205	NA	215	NA	220	NA	220
Gold (recoverable content of ores, etc.) troy ounces	2,966	122	3,974	233	3,647	357	5,049	807
Gypsum thousand short tons	1,352	3,884	1,525	4,965	1,778	5,834	1,716	6,642
Lead (recoverable content of ores, etc.) short tons	2,284	630	1,153	347	44	44	35	16
Lime thousand short tons	630	10,846	608	13,059	632	13,602	600	14,877
Magnesium compounds from seawater and bitterns (partly estimated) short tons, MgO equivalent	152,918	16,836	175,654	18,421	184,105	19,233	163,847	18,356
Mercury 76-pound flasks	13,489	3,944	5,835	1,274	1,219	349	1,311	370
Natural gas million cubic feet	612,629	199,717	487,278	179,318	449,369	167,615	365,354	160,756
Natural gas liquids:								
Natural gasoline and cycle products thousand 42-gallon barrels	11,045	35,545	8,468	27,664	6,865	23,475	5,709	26,104
LP gases do	6,755	16,482	5,847	15,962	5,329	19,824	5,095	29,296
Peat thousand short tons	12	W	29	620	21	373	14	322
Petroleum (crude) thousand 42-gallon barrels	358,484	975,076	347,022	940,430	336,075	1,045,193	323,003	1,710,350
Pumice thousand short tons	699	1,179	731	1,507	768	3,237	909	3,219
Rare-earth metal concentrates short tons	--	--	W	W	W	W	34,284	15,798
Salt thousand short tons	1,887	21,142	1,621	14,860	1,507	15,533	W	W
Sand and gravel do	115,468	157,683	117,288	162,619	117,470	176,286	105,191	176,213
Silver (recoverable content of ores, etc.) thousand troy ounces	444	686	175	296	56	143	42	197
Stone thousand short tons	43,336	86,255	37,213	65,811	43,838	77,175	45,709	91,891
Talc, soapstone, pyrophyllite short tons	153,227	2,084	155,155	1,186	179,191	1,501	161,154	1,682
Zinc (recoverable content of ores, etc.) do	3,003	967	1,202	427	20	8	8	6
Value of items that cannot be disclosed: Bromine, calcium-magnesium chloride, carbon dioxide, cement (masonry 1971–73), coal (lignite, 1971–72), diatomite, feldspar, iron ore, lithium minerals, molybdenum, perlite, potassium salts, sodium carbonate and sulfate, tungsten concentrate, and values indicated by symbol W	XX	112,218	XX	107,266	XX	137,843	XX	187,509
Total	XX	1,920,723	XX	1,851,376	XX	2,041,686	XX	2,797,080
COLORADO								
Carbon dioxide thousand cubic feet	W	W	W	W	W	W	123,106	W
Clays thousand short tons	625	1,334	747	1,533	794	1,710	663	1,588
Coal (bituminous) do	5,337	33,813	5,522	35,637	6,233	46,190	6,896	64,677
Copper (recoverable content of ores, etc.) short tons	3,938	4,096	3,944	4,039	3,123	3,716	3,012	4,657
Feldspar do	571	4	W	W	W	W	W	W
Gem stones	NA	125	NA	131	NA	131	NA	135
Gold (recoverable content of ores, etc.) troy ounces	42,031	1,734	61,100	3,580	63,422	6,203	52,083	8,320
Gypsum thousand short tons	W	W	W	W	151	568	191	800
Lead (recoverable content of ores, etc.) short tons	25,746	7,106	31,346	9,423	28,112	9,159	24,609	11,074

See footnotes at end of table.

Table 6.—Mineral production [1] in the United States, by State—Continued

Mineral	1971		1972		1973		1974	
	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)
COLORADO—Continued								
Lime ---- thousand short tons --	193	$3,039	187	$4,070	178	$3,871	198	$3,815
Mica, sheet ---- pounds --	8,300	4	14,280	7	--	--	--	--
Natural gas ---- million cubic feet --	108,537	16,932	116,949	19,297	137,725	24,304	144,629	28,926
Natural gas liquids:								
Natural gasoline and cycle products thousand 42-gallon barrels --	929	2,462	1,245	3,349	1,424	4,295	1,574	9,319
LP gases ---- do ----	1,653	3,190	1,749	3,673	1,978	6,488	2,580	14,190
Peat ---- thousand short tons --	28	156	39	210	28	163	30	201
Petroleum (crude) ---- thousand 42-gallon barrels --	27,391	92,855	32,015	109,171	36,590	155,507	37,508	283,904
Pumice ---- thousand short tons --	62	W	59	W	W	W	W	W
Sand and gravel ---- do ----	27,000	30,155	28,318	34,631	33,767	45,493	23,793	39,674
Silver (recoverable content of ores, etc.) thousand troy ounces --	3,390	5,241	3,664	6,174	r 3,590	r 9,204	2,784	13,113
Stone ---- thousand short tons --	3,785	7,938	4,507	9,599	6,357	14,003	6,572	15,109
Uranium (recoverable content U_3O_8) thousand pounds --	2,586	15,725	1,877	11,825	r 1,888	r 12,274	W	W
Zinc (recoverable content of ores, etc.) -- short tons --	61,181	19,700	63,801	22,649	58,339	24,106	49,489	35,533
Value of items that cannot be disclosed: Beryllium concentrate (1971–72), cement, fluorspar, iron ore, mica (scrap 1971), molybdenum, perlite, pyrites, salt, tin, tungsten, vanadium and values indicated by symbol W -	XX	147,117	XX	146,843	XX	164,806	XX	215,264
Total ----	XX	392,721	XX	425,841	XX	r 531,691	XX	750,299
CONNECTICUT								
Clays ---- thousand short tons --	174	322	157	292	162	320	156	363
Feldspar ---- short tons --	W	W	W	W	77,206	W	W	W
Gem stones ----	NA	15	NA	16	NA	16	NA	15
Lime ---- thousand short tons --	W	W	W	W	W	W	33	1,148
Mica scrap ---- thousand short tons --	3	W	2	W	3	W	2	W
Sand and gravel ---- do ----	6,921	10,262	6,763	11,270	7,806	12,788	6,345	11,272
Stone ---- do ----	7,193	15,649	8,719	19,695	9,682	21,305	8,457	21,134
Value of items that cannot be disclosed: Mica (sheet, 1974) and values indicated by symbol W ----	XX	1,713	XX	1,850	XX	2,375	XX	1,430
Total ----	XX	27,961	XX	33,123	XX	36,804	XX	35,362
DELAWARE								
Clays ---- thousand short tons --	14	8	15	9	15	9	14	8
Gem stones ----	NA	2	NA	W	NA	W	NA	2
Sand and gravel ---- thousand short tons --	2,205	2,231	2,257	2,660	3,408	3,678	2,396	3,783
Value of items that cannot be disclosed: Other nonmetals and values indicated by symbol W ----	--	--	XX	202	XX	202	XX	W
Total ----	**XX**	**2,241**	**XX**	**2,871**	**XX**	**3,889**	**XX**	**e 3,793**

FLORIDA								
Cement:								
Masonry thousand short tons	180	4,877	213	6,901	256	8,706	235	4,737
Portland do	2,177	48,970	2,425	59,773	2,725	72,666	2,562	75,133
Clays do	[3]993	[3]12,834	[3]922	[3]10,336	1,139	13,718	[3]808	[3]14,261
Lime do	159	2,958	180	3,527	187	4,026	185	5,315
Natural gas million cubic feet	903	270	15,521	4,967	33,857	11,613	38,137	20,441
Peat thousand short tons	57	412	45	362	44	384	67	616
Petroleum (crude) thousand 42-gallon barrels	5,347	W	16,897	W	32,695	150,070	36,351	351,331
Sand and gravel thousand short tons	23,228	18,836	22,363	17,009	20,167	21,415	24,372	33,400
Stone [4] do	42,816	64,332	53,093	81,621	61,735	103,595	54,560	100,378
Titanium concentrates (rutile) short tons	--	--	W	W	9,045	1,212	6,446	996
Value of items that cannot be disclosed: Clay (kaolin, except 1973), kyanite, magnesium compounds, natural gas liquids, phosphate, rock, rare-earth metal concentrate (1972–74), staurolite, stone (dimension), titanium concentrate (ilmenite), zircon concentrate, and values indicated by symbol W	XX	190,242	XX	242,136	XX	[r] 213,695	XX	437,287
Total	XX	343,731	XX	426,632	XX	601,100	XX	1,043,895
GEORGIA								
Cement:								
Masonry thousand short tons	63	1,470	68	1,569	67	2,126	40	1,304
Portland do	1,214	22,470	1,260	27,286	1,201	28,124	1,150	31,535
Clays [3] do	5,791	119,096	6,227	132,322	7,721	160,419	7,692	203,936
Feldspar short tons	W	W	W	W	51,523	W	W	W
Peat thousand short tons	1	13	W	W	(5)	4	1	6
Sand and gravel do	3,697	5,310	3,816	4,729	4,976	6,781	4,989	9,639
Stone do	30,669	69,897	37,074	82,484	40,841	97,506	40,321	105,582
Talc short tons	53,000	334	45,842	338	38,000	114	33,850	102
Value of items that cannot be disclosed: Barite, bauxite, fire clay, kyanite, mica (scrap), rare-earth metal concentrate, titanium concentrate, zircon concentrate, and values indicated by symbol W	XX	10,895	XX	9,589	XX	10,405	XX	10,996
Total	XX	229,485	XX	258,317	XX	305,479	XX	363,100
HAWAII								
Cement:								
Masonry thousand short tons	11	431	13	384	16	537	14	706
Portland do	375	10,196	402	10,732	453	13,213	487	16,405
Gem stones	NA	54	NA	57	NA	W	NA	W
Lime thousand short tons	8	228	7	266	6	238	6	221
Pumice, pumicite, volcanic ash do	289	779	379	762	354	611	385	792
Sand and gravel do	836	1,967	609	1,893	753	2,012	990	2,379
Stone do	[4]6,056	[4]14,357	[4]5,005	[4]13,494	7,180	18,466	[4]7,638	[4]21,370
Value of items that cannot be disclosed: Clays, salt, stone (dimension, except 1973), and values indicated by symbol W	XX	95	XX	486	XX	70	XX	169
Total	**XX**	**28,107**	**XX**	**28,074**	**XX**	**35,147**	**XX**	**42,042**

See footnotes at end of table.

Table 6.—Mineral production[1] in the United States, by State—Continued

Mineral	1971		1972		1973		1974	
	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)
	IDAHO							
Antimony ore and concentrate short tons, antimony content	857	$817	345	$303	322	$406	445	W
Clays thousand short tons	W	W	57	415	42	227	[3]9	[3]$10
Copper (recoverable content of ores, etc.) short tons	3,776	3,927	2,942	3,013	3,625	4,314	2,841	4,393
Gem stones	NA	100	NA	105	NA	110	NA	120
Gold (recoverable content of ores, etc.) troy ounces	3,596	148	2,884	169	2,696	264	2,898	463
Gypsum thousand short tons	--	--	--	--	W	W	W	W
Lead (recoverable content of ores, etc.) short tons	66,610	18,384	61,407	18,459	61,744	20,116	51,717	23,273
Mercury 76-pound flasks	1,057	309	161	35	--	--	--	--
Peat thousand short tons	W	W	--	--	--	--	--	--
Pumice do	W	W	W	W	80	110	108	182
Sand and gravel do	11,279	11,437	7,696	10,294	8,393	10,246	7,665	10,484
Silver (recoverable content of ores, etc.) thousand troy ounces	19,140	29,590	14,251	24,012	13,620	34,840	12,436	58,572
Stone thousand short tons	4,149	6,118	3,094	7,042	2,972	8,096	3,528	9,868
Tungsten concentrate thousand pounds contained W	r 24	66	W	W	W	W	W	W
Zinc (recoverable content of ores, etc.) short tons	45,078	14,515	38,647	13,720	46,107	19,052	39,469	28,339
Value of items that cannot be disclosed: Cement, clays, (fire clay and kaolin, 1971, 1974), fluorspar (1971), abrasive garnet, iron ore, lime, perlite, phosphate rock, vanadium, and values indicated by symbol W	XX	26,869	XX	28,639	XX	38,300	XX	72,854
Total	XX	112,280	XX	106,206	XX	136,081	XX	208,558
	ILLINOIS							
Cement:								
Masonry thousand short tons	73	2,336	80	2,483	88	2,901	69	3,228
Portland do	1,425	25,975	1,571	33,124	1,572	36,064	1,460	41,023
Clays do	1,788	4,294	[3]1,716	[3]3,314	[3]1,758	[3]3,613	[3]1,587	[3]3,744
Coal (bituminous) do	58,402	318,878	65,523	402,481	61,572	413,309	58,215	582,010
Fluorspar short tons	138,051	9,883	132,405	9,961	160,305	11,871	153,698	12,247
Gem stones	NA	2	NA	2	NA	2	NA	2
Lead (recoverable content of ores, etc.) short tons	1,238	342	1,335	401	541	176	493	222
Natural gas million cubic feet	498	139	1,194	334	1,688	573	1,436	574
Peat thousand short tons	72	W	74	935	72	1,037	96	1,412
Petroleum (crude) thousand 42-gallon barrels	39,084	135,621	34,874	121,013	30,669	132,490	27,553	244,395
Sand and gravel thousand short tons	45,364	59,397	39,929	61,696	43,649	62,029	42,705	68,566
Stone do	[4]61,991	[4]106,084	[4]56,260	[4]94,225	66,653	114,068	63,231	121,763
Zinc (recoverable content of ores, etc.) short tons	12,706	4,091	11,378	4,039	5,250	2,169	4,104	2,947
Value of items that cannot be disclosed: Barite (1974), clay (fuller's earth, except 1971), copper (1974), lime, natural gas liquids, silver, stone (dimension, 1971–72), tripoli, and values indicated by symbol W	XX	33,828	XX	35,729	XX	45,306	XX	67,077
Total	**XX**	**700,870**	**XX**	**769,787**	**XX**	**825,608**	**XX**	**1,149,210**

INDIANA								
Clays ---------- thousand short tons --	[3]1,324	[3]2,308	[3]1,419	[3]2,465	1,486	2,568	1,092	1,947
Coal (bituminous) ---------- do ----	21,396	110,796	25,949	144,688	25,253	153,130	23,726	198,410
Natural gas ---------- million cubic feet --	537	89	355	55	276	38	176	25
Peat ---------- thousand short tons --	50	W	45	478	51	475	71	946
Petroleum (crude) ---------- thousand 42-gallon barrels --	6,658	22,770	6,130	20,964	5,312	20,823	4,919	42,402
Sand and gravel ---------- thousand short tons --	24,982	29,094	27,978	33,290	27,731	35,015	26,077	35,656
Stone ---------- do ----	26,233	48,218	27,511	50,919	[4]32,288	[4]57,652	[4]31,031	[4]64,106
Value of items that cannot be disclosed: Abrasive stone, cement, clay (fire, 1971–72), gypsum, lime, sandstone (1973–74), and values indicated by symbol W ----------	XX	68,246	XX	69,749	XX	81,698	XX	97,198
Total ----------	XX	281,521	XX	322,608	XX	351,405	XX	440,690
IOWA								
Cement:								
Masonry ---------- thousand short tons --	66	1,719	66	1,916	68	2,351	65	2,660
Portland ---------- do ----	2,392	47,925	2,458	49,635	2,688	59,574	2,424	64,156
Clays ---------- do ----	[3]1,028	[3]1,702	1,047	2,643	967	2,028	960	1,869
Coal (bituminous) ---------- do ----	989	4,609	851	4,188	601	3,279	590	4,591
Gem stones ----------	W	W	NA	1	NA	W	NA	W
Gypsum ---------- thousand short tons --	1,154	4,460	1,380	5,714	1,470	6,234	1,397	7,142
Sand and gravel ---------- do ----	18,279	20,530	17,107	20,140	19,950	25,541	17,091	26,104
Stone ---------- do ----	[4]25,389	[4]44,977	27,457	48,642	31,541	56,918	32,342	66,119
Value of items that cannot be disclosed: Clay (fire, 1971), lime, peat, stone (dimension, 1971), and values indicated by symbol W ----------	XX	1,899	XX	1,667	XX	2,785	XX	4,079
Total ----------	XX	127,821	XX	134,496	XX	158,800	XX	176,720
KANSAS								
Cement:								
Masonry ---------- thousand short tons --	50	1,232	59	1,452	73	2,068	64	2,203
Portland ---------- do ----	1,731	29,961	1,889	35,432	2,026	42,172	1,940	46,940
Clays ---------- do ----	879	1,151	1,170	1,457	1,169	1,490	1,311	1,785
Coal (bituminous) ---------- do ----	1,151	6,579	1,227	7,835	1,086	7,979	718	5,463
Helium:								
Crude ---------- million cubic feet --	2,510	30,120	2,278	27,336	1,539	18,468	W	W
High-purity ---------- do ----	342	7,182	384	8,064	416	8,736	499	11,477
Lime ---------- thousand short tons --	8	W	9	172	10	199	28	535
Natural gas ---------- million cubic feet --	885,144	127,267	889,268	127,859	893,118	138,521	886,782	147,206
Natural gas liquids:								
Natural gasoline ---------- thousand 42-gallon barrels --	5,387	12,253	5,505	13,170	5,993	17,685	6,630	24,810
LP gases ---------- do ----	23,215	39,001	25,099	43,170	24,463	53,819	24,402	78,818
Petroleum (crude) ---------- do ----	78,532	276;433	73,744	259,578	66,227	281,465	61,691	490,984
Salt [7] ---------- thousand short tons --	1,240	18,712	1,369	20,562	1,397	23,460	1,367	27,007
Sand and gravel ---------- do ----	11,862	11,351	11,591	10,920	13,261	12,663	11,687	13,388
Stone ---------- do ----	[4]14,908	23,697	[4]14,547	[4]23,849	[4]18,334	[4]33,601	[4]17,869	34,869
Value of items that cannot be disclosed: Gypsum, pumice, salt (brine), stone (dimension), and values indicated by symbol W ----------	XX	4,505	XX	3,741	XX	3,973	XX	3,913
Total ----------	XX	589,444	XX	584,597	XX	646,299	XX	889,398

See footnotes at end of table.

Table 6.—Mineral production[1] in the United States, by State—Continued

Mineral	1971		1972		1973		1974	
	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)
	KENTUCKY							
Clays [3] ______ thousand short tons	956	$1,377	920	$1,406	1,083	$1,961	848	$1,477
Coal (bituminous) ______ do	119,389	774,735	121,188	824,691	127,645	986,654	137,197	2,340,961
Natural gas ______ million cubic feet	72,723	18,253	63,648	15,976	62,396	21,839	71,876	35,938
Petroleum (crude) ______ thousand 42-gallon barrels	10,692	35,925	9,702	32,599	8,687	34,515	7,837	68,340
Sand and gravel ______ thousand short tons	8,202	11,061	8,485	11,967	10,331	14,627	8,710	12,887
Stone ______ do	[4]32,514	[4]52,296	[4]34,279	[4]59,690	[4]38,205	[4]70,912	34,542	66,632
Zinc (recoverable content of ores, etc.) ______ short tons	5,268	1,696	1,780	632	273	113	--	--
Value of items that cannot be disclosed: Cement, clay (ball), fluorspar, lime, natural gas liquids, and stone (quartzite, 1971–73) ______	XX	30,542	XX	29,949	XX	34,141	XX	36,975
Total ______	XX	925,885	XX	976,910	XX	1,164,762	XX	2,563,210
	LOUISIANA							
Clays ______ thousand short tons	1,073	1,606	1,000	1,454	979	1,329	770	1,425
Lime ______ do	960	17,625	908	19,614	897	16,801	796	17,665
Natural gas ______ million cubic feet	8,081,907	1,632,545	7,972,678	1,626,426	8,242,423	1,846,303	7,753,631	2,380,365
Natural gas liquids:								
Natural gasoline and cycle products thousand 42-gallon barrels	54,424	173,425	52,842	167,768	47,906	167,037	35,860	234,954
LP gases ______ do	90,271	166,099	99,233	185,660	102,701	253,671	108,439	423,996
Petroleum (crude) ______ do	935,243	3,359,710	891,827	3,201,659	831,524	3,327,702	737,324	4,811,772
Salt ______ thousand short tons	13,352	67,950	13,514	67,464	13,152	66,211	13,543	76,960
Sand and gravel ______ do	19,228	24,492	18,920	26,996	13,748	21,165	12,341	27,781
Stone [4] ______ do	9,688	14,139	9,190	14,836	10,802	21,309	10,940	24,046
Sulfur (Frasch process) ______ thousand long tons	3,646	W	3,765	W	3,329	W	W	W
Value of items that cannot be disclosed: Cement, gypsum, stone (miscellaneous), and values indicated by symbol W ______	XX	94,739	XX	99,666	XX	98,082	XX	147,614
Total ______	XX	5,552,330	XX	5,411,543	XX	5,819,610	XX	8,146,578
	MAINE							
Clays ______ thousand short tons	[3]42	[3]56	40	57	41	74	146	183
Copper ______ short tons	2,510	2,610	1,220	1,249	1,107	1,317	1,522	2,353
Gem stones ______	NA	40	NA	W	NA	W	NA	W
Lead ______ short tons	--	--	85	26	204	66	279	126
Peat ______ thousand short tons	2	W	2	99	5	177	4	194
Sand and gravel ______ do	8,292	5,881	11,818	7,535	13,583	10,304	8,755	10,673
Silver ______ thousand troy ounces	41	64	16	27	W	W	W	W
Stone ______ thousand short tons	1,133	2,913	1,078	2,996	1,212	3,329	1,491	4,255
Zinc (recoverable content of ore, etc.) ______ short tons	5,850	1,884	5,820	2,066	19,640	8,115	10,425	7,485
Value of items that cannot be disclosed: Cement, clays (1971), and values indicated by symbol W ______	XX	8,540	XX	8,867	XX	10,111	XX	11,079
Total ______	**XX**	**21,898**	**XX**	**22,922**	**XX**	**33,493**	**XX**	**36,348**

MARYLAND								
Clays [3] thousand short tons	1,027	1,558	1,104	2,121	897	1,973	884	2,066
Coal (bituminous) do	1,644	10,274	1,640	8,961	1,789	13,644	2,337	48,630
Gem stones	NA	8	NA	8	NA	8	NA	8
Lime thousand short tons	W	W	W	W	W	W	23	527
Natural gas million cubic feet	214	43	244	51	298	69	133	32
Peat thousand short tons	3	39	3	29	2	29	3	45
Sand and gravel do	12,842	23,201	12,594	26,557	12,845	29,625	11,690	29,386
Stone do	15,912	34,770	19,431	41,973	18,585	46,732	18,072	47,630
Value of items that cannot be disclosed: Cement, clay (selected), lime (1971–73), greensand marl (1971), talc, soapstone, and values indicated by symbol W	XX	29,527	XX	35,801	XX	39,827	XX	44,556
Total	XX	99,420	XX	115,501	XX	131,907	XX	172,880
MASSACHUSETTS								
Clays thousand short tons	186	377	219	416	217	404	218	379
Gem stones	NA	5	NA	5	NA	5	NA	5
Lime thousand short tons	W	W	W	W	W	W	170	4,972
Peat do	2	32	W	W	2	78	3	85
Sand and gravel do	17,343	23,058	18,883	25,655	18,743	26,910	17,334	26,565
Stone do	7,816	23,582	7,990	23,500	8,580	28,738	8,103	30,103
Value of items that cannot be disclosed: Nonmetals and values indicated by symbol W (1971–73)	XX	3,145	XX	2,852	XX	3,547	XX	--
Total	XX	50,199	XX	52,428	XX	59,682	XX	62,109
MICHIGAN								
Cement:								
Masonry thousand short tons	239	5,872	250	5,959	247	6,185	217	6,309
Portland do	6,108	104,665	5,901	111,410	6,242	123,442	5,903	140,513
Clays do	2,458	3,366	2,514	3,715	2,151	3,304	2,161	4,074
Copper (recoverable content of ores, etc.) short tons	56,005	58,245	67,260	68,874	72,221	85,943	67,012	103,601
Gem stones	NA	8	NA	8	NA	8	NA	8
Gypsum thousand short tons	1,433	5,585	1,650	7,267	1,882	8,538	1,482	7,258
Iron ore (usable) thousand long tons, gross weight	11,833	159,854	12,692	177,461	12,389	180,194	11,602	213,598
Lime thousand short tons	1,444	20,549	1,509	22,753	1,545	26,055	1,528	30,036
Magnesium compounds from seawater and brine (except for metal) short tons, MgO equivalent	272,918	27,777	377,675	31,484	455,501	41,790	503,281	53,302
Natural gas million cubic feet	25,662	6,776	34,221	10,506	44,579	17,495	69,133	34,843
Natural gas liquids:								
Natural gasoline thousand 42-gallon barrels	553	1,513	395	1,097	372	1,189	466	3,089
LP gases do	975	2,623	833	2,274	691	2,529	849	5,383
Peat thousand short tons	202	2,497	219	2,190	232	2,172	244	3,811
Petroleum (crude) thousand 42-gallon barrels	11,893	38,859	12,990	41,556	14,614	59,413	18,021	154,746
Salt thousand short tons	4,458	49,007	4,358	50,761	4,818	53,732	4,445	62,055
Sand and gravel do	56,613	62,898	59,467	65,445	62,407	73,972	60,027	82,617
Silver (recoverable content of ores, etc.) **thousand troy ounces**	**670**	**1,036**	**785**	**1,823**	**850**	**2,175**	**643**	**3,028**
Stone thousand short tons	**40,705**	**49,240**	**39,754**	**50,317**	**45,886**	**60,494**	**47,479**	**72,748**
Value of items that cannot be disclosed: Bromine, calcium-magnesium chloride, and iodine	**XX**	**40,266**	**XX**	**40,367**	**XX**	**40,392**	**XX**	**59,048**
Total	**XX**	**640,636**	**XX**	**694,767**	**XX**	**789,022**	**XX**	**1,040,067**

See footnotes at end of table.

Table 6.—Mineral production [1] in the United States, by State—Continued

Mineral	1971		1972		1973		1974	
	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)
		MINNESOTA						
Clays thousand short tons	223	$335	[3]167	[3]$251	[3]156	[3]$233	W	W
Gem stones	NA	13	NA	14	NA	14	NA	$14
Iron ore (usable) thousand long tons, gross weight	49,054	547,607	50,595	601,869	62,614	782,197	59,422	949,678
Manganiferous ore (5% to 35% Mn) short tons, gross weight	169,732	W	119,324	W	170,971	W	225,560	W
Peat thousand short tons	W	W	W	W	W	W	20	471
Sand and gravel do	44,916	37,645	36,792	33,454	37,935	39,438	36,720	42,370
Stone do	5,838	14,346	5,757	16,318	7,581	20,411	8,301	22,041
Value of items that cannot be disclosed: Abrasive stones, cement, clays (selected, 1972–74), lime, and values indicated by symbol W	XX	8,830	XX	7,763	XX	10,492	XX	11,792
Total	XX	608,776	XX	659,669	XX	852,785	XX	1,026,366
		MISSISSIPPI						
Clays thousand short tons	2,278	8,501	1,919	7,837	2,075	9,082	2,013	10,468
Lime do	W	W	W	W	W	W	70	1,393
Natural gas million cubic feet	118,805	24,830	103,989	22,670	99,706	22,846	78,787	23,242
Petroleum (crude) thousand 42-gallon barrels	64,066	201,808	61,100	192,465	56,102	213,747	50,779	309,753
Sand and gravel thousand short tons	11,289	13,526	13,419	16,133	14,251	17,383	14,939	19,487
Stone do	726	709	1,135	1,199	[4]760	[4]809	1,719	2,572
Value of items that cannot be disclosed: Cement, magnesium compounds, natural gas liquids, limestone (1973), and values indicated by symbol W	XX	12,790	XX	14,970	XX	17,871	XX	24,240
Total	XX	262,164	XX	255,274	XX	281,738	XX	391,155
		MISSOURI						
Barite thousand short tons	232	3,606	213	3,637	196	3,395	177	3,386
Cement:								
Masonry do	73	1,629	80	1,859	84	2,400	75	2,434
Portland do	4,515	77,568	4,277	80,898	4,582	99,858	4,229	106,985
Clays do	[3]2,354	[3]7,454	[3]2,571	[3]9,096	2,551	11,626	[3]2,565	[3]13,151
Coal (bituminous) do	4,036	19,670	4,551	23,667	4,658	24,999	4,623	29,383
Copper (recoverable content of ores, etc.) short tons	8,445	8,783	11,509	11,785	10,273	12,224	12,665	19,580
Iron ore (usable) thousand long tons, gross weight	2,727	W	2,695	W	2,630	W	1,866	W
Lead (recoverable content of ores, etc.) short tons	429,634	118,579	489,397	147,113	487,143	158,711	562,097	252,944
Lime thousand short tons	W	W	W	W	1,626	23,534	1,901	36,369
Natural gas million cubic feet	22	5	9	2	33	8	33	10
Petroleum (crude) thousand 42-gallon barrels	66	W	60	W	60	W	56	W
Phosphate rock thousand short tons	--	--	--	--	42	W	35	W
Sand and gravel do	10,327	15,109	10,082	14,806	10,879	16,950	10,933	19,462
Silver (recoverable content of ores, etc.) thousand troy ounces	1,661	2,568	1,972	3,322	2,058	5,264	2,387	11,244
Stone thousand short tons	41,099	[4]64,772	42,473	[4]63,219	49,304	79,921	50,626	90,204
Zinc (recoverable content of ores, etc.) short tons	48,215	15,525	61,923	21,983	82,350	34,027	91,987	66,047
Value of items that connot be disclosed: Asphalt (native), clays (selected, except 1973), and values indicated by symbol W	XX	64,821	XX	70,430	XX	39,717	XX	39,850
Total	**XX**	**400,089**	**XX**	**451,817**	**XX**	**512,634**	**XX**	**691,049**

MONTANA								
Antimony short tons	135	81	W	W	W	W	W	W
Clays[3] thousand short tons	264	1,712	304	1,590	219	1,298	298	2,189
Coal (bituminous and lignite) do	7,064	12,817	8,221	16,690	10,725	30,238	14,106	54,961
Copper (recoverable content of ores, etc.) short tons	88,581	92,125	123,110	126,064	132,466	157,634	131,131	202,728
Gem stones	NA	114	NA	120	NA	150	NA	400
Gold (recoverable content of ores, etc.) troy ounces	15,613	644	23,725	1,390	27,806	2,720	28,268	4,516
Iron ore (usable) thousand long tons, gross weight	14	W	9	W	13	W	30	W
Lead (recoverable content of ores, etc.) short tons	615	169	287	86	176	57	154	69
Lime thousand short tons	199	2,416	242	3,003	210	3,028	226	3,364
Manganese ore and concentrate (35% or more Mn) short tons, gross weight	142	W	578	W	239	W	--	--
Natural gas million cubic feet	32,720	3,959	33,474	4,117	56,175	13,240	54,873	13,883
Peat thousand short tons	W	W	1	W	1	W	W	W
Petroleum (crude) thousand 42-gallon barrels	34,599	104,128	33,904	103,924	34,620	115,423	34,554	229,802
Sand and gravel thousand short tons	15,781	25,207	10,116	17,149	11,694	13,819	4,242	6,126
Silver (recoverable content of ores, etc.) thousand troy ounces	2,748	4,248	3,325	5,603	4,350	11,127	3,512	16,542
Stone thousand short tons	W	W	4,074	5,627	5,054	9,559	[4]3,115	[4]6,242
Zinc (recoverable content of ores, etc.) short tons	361	116	12	4	73	30	136	98
Value of items that cannot be disclosed: Cement, clays (selected), fluorspar, gypsum, natural gas liquids, phosphate rock, stone (1971, dimension 1974), talc, tungsten ore and concentrate, vermiculite and values indicated by symbol W	XX	37,337	XX	22,309	XX	26,962	XX	33,881
Total	XX	285,073	XX	307,676	XX	385,285	XX	574,801
NEBRASKA								
Clays thousand short tons	69	82	115	143	158	286	182	414
Gem stones	NA	10	NA	11	NA	11	NA	11
Lime thousand short tons	29	W	34	685	31	651	36	591
Liquefied petroleum gases thousand 42-gallon barrels	W	W	W	W	W	W	W	W
Natural gas (marketed) million cubic feet	3,496	612	3,478	619	3,836	698	2,538	863
Petroleum (crude) thousand 42-gallon barrels	10,062	34,010	8,705	29,423	7,240	28,035	6,611	45,167
Sand and gravel	13,224	13,626	13,720	15,063	15,906	18,366	13,231	17,727
Stone do	4,174	7,892	4,251	7,645	5,368	10,958	4,630	10,364
Value of items that cannot be disclosed: Cement, natural gasoline, pumice (1971–72), and values indicated by symbol W	XX	17,847	XX	20,086	XX	21,816	XX	23,497
Total	**XX**	**74,079**	**XX**	**73,675**	**XX**	**80,821**	**XX**	**98,634**
NEVADA								
Barite thousand short tons	**192**	**1,490**	**317**	**2,659**	**549**	**4,691**	**761**	**8,115**
Clays do	**W**	**W**	**40**	**183**	**36**	**176**	**39**	**218**
Copper (recoverable content of ores, etc.) short tons	**96,928**	**100,806**	**101,119**	**103,545**	**93,702**	**111,505**	**84,101**	**130,021**
Gem stones	**NA**	**105**	**NA**	**110**	**NA**	**142**	**NA**	**400**
Gold (recoverable content of ores, etc.) troy ounces	**374,878**	**15,464**	**419,748**	**24,597**	**260,437**	**25,473**	**298,754**	**47,728**
Gypsum thousand short tons	**695**	**2,372**	**860**	**2,871**	**1,154**	**3,662**	**843**	**2,959**
Iron ore (usable) thousand long tons, gross weight	**W**	**W**	**W**	**W**	**119**	**W**	**139**	**W**
Lead (recoverable content of ores, etc.) short tons	**111**	**30**	**(5)**	**(5)**	**--**	**--**	**1,785**	**803**

See footnotes at end of table.

Table 6.—Mineral production[1] in the United States, by State—Continued

Mineral	1971		1972		1973		1974	
	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)
NEVADA—Continued								
Mercury ---- 76-pound flasks --	1,589	$465	810	$177	698	$200	W	W
Perlite ---- short tons --	9,600	114	W	W	W	W	W	W
Petroleum (crude) ---- thousand 42-gallon barrels --	113	W	100	W	96	W	129	W
Pumice ---- thousand short tons --	112	232	W	W	W	W	W	W
Sand and gravel ---- do ----	9,379	12,225	10,081	12,636	12,448	14,614	8,736	$14,515
Silver (recoverable content of ores, etc.) thousand troy ounces --	601	930	595	1,008	624	1,595	872	4,108
Stone ---- thousand short tons --	2,531	3,800	3,329	5,926	3,595	5,429	2,186	4,203
Tungsten ore and concentrate thousand pounds contained W --	r 31	88	r 157	W	150	377	132	537
Zinc (recoverable content of ores, etc.) -- short tons --	71	23	--	--	--	--	3,405	2,445
Value of items that cannot be disclosed: Antimony, brucite (1971), cement, diatomite, fluorspar, lime, lithium minerals, magnesite, molybdenum, pyrites, (1971), salt, talc (1972–74), and values indicated by symbol W ----	XX	26,680	XX	27,995	XX	33,949	XX	41,829
Total ----	XX	164,774	XX	181,702	XX	201,813	XX	257,876
NEW HAMPSHIRE								
Clays ---- thousand short tons --	37	34	51	70	43	64	34	55
Gem stones ----	NA	40	NA	42	NA	42	NA	42
Sand and gravel ---- thousand short tons --	8,404	6,777	6,020	6,256	7,795	8,597	6,126	8,223
Stone ---- do ----	429	3,433	528	3,743	1,836	5,416	590	5,371
Total ----	XX	10,284	XX	10,111	XX	14,119	XX	13,691
NEW JERSEY								
Clays ---- thousand short tons --	201	864	212	856	183	666	104	524
Gem stones ----	NA	15	NA	16	NA	16	NA	16
Peat ---- thousand short tons --	46	526	W	W	44	514	31	603
Sand and gravel ---- do ----	18,511	38,279	17,679	38,020	19,040	43,098	17,924	47,292
Stone[4] ---- do ----	13,469	36,057	15,223	42,044	15,902	45,585	15,749	52,456
Zinc (recoverable content of ores, etc.) -- short tons --	29,977	9,653	38,096	13,524	33,027	13,647	32,848	23,585
Value of items that cannot be disclosed: Lime (1971–73), magnesium compounds, manganiferous residuum, greensand marl, stone (dimension), titanium concentrate, and values indicated by symbol W ----	XX	8,178	XX	8,261	XX	10,490	XX	16,272
Total ----	XX	93,572	XX	102,721	XX	114,016	XX	140,748
NEW MEXICO								
Clays[5] ---- thousand short tons --	76	114	65	108	88	169	55	317
Coal (bituminous) ---- do ----	8,175	26,657	8,248	29,794	9,069	31,862	9,392	W
Copper (recoverable content of ores, etc.) - short tons --	157,419	168,716	168,084	172,067	204,742	243,643	196,585	303,920
Gem stones ----	NA	65	NA	63	NA	70	NA	200
Gold (recoverable content of ores, etc.) -- troy ounces --	10,681	441	14,897	873	13,864	1,256	15,427	2,464

Gypsum thousand short tons	W	W	W	W	255	1,220	157	532
Helium (high purity) million cubic feet	W	W	--	--	--	--	--	--
Iron ore (usable) thousand long tons, gross weight	W	W	W	W	5	114	6	135
Lead (recoverable content of ores, etc.) short tons	2,971	820	3,582	1,077	2,556	833	2,364	1,064
Lime thousand short tons	35	W	28	W	44	798	58	1,679
Manganiferous ore (5% to 35% Mn) short tons, gross weight	28,490	W	27,837	W	32,084	W	47,348	W
Mica, scrap thousand short tons	W	W	14	W	10	82	12	60
Natural gas million cubic feet	1,167,577	175,137	1,216,061	225,420	1,218,749	287,889	1,744,779	390,861
Natural gas liquids:								
Natural gasoline and cycle products thousand 42-gallon barrels	9,952	28,465	10,338	29,970	9,848	32,449	9,713	53,545
LP gases do	27,082	48,331	27,859	45,689	29,652	74,427	30,271	120,781
Peat thousand short tons	1	W	2	46	3	50	4	111
Perlite do	386	4,559	476	5,698	478	5,024	480	6,306
Petroleum (crude) thousand 42-gallon barrels	118,412	402,602	110,525	376,778	100,986	414,041	98,695	712,578
Potassium salts thousand short tons, K₂O equivalent	2,291	86,689	2,296	91,115	2,168	91,996	2,102	128,588
Pumice thousand short tons	287	601	311	809	339	1,001	471	1,466
Salt do	146	1,130	W	W	W	W	167	W
Sand and gravel do	8,869	7,975	7,600	8,553	10,641	15,753	7,413	10,605
Silver (recoverable content of ores, etc.) thousand troy ounces	782	1,210	1,017	1,718	1,111	2,848	1,195	5,628
Stone thousand short tons	[4]2,918	[4]5,337	2,768	5,499	2,830	5,894	[4]3,531	[4]8,859
Tin long tons	--	--	--	--	W	W	W	W
Uranium (recoverable content U_3O_8) thousand pounds	10,567	65,517	10,808	68,091	r 9,286	r 60,356	9,971	104,693
Zinc (recoverable content of ores, etc.) short tons	13,959	4,495	12,735	4,521	12,327	5,094	13,784	9,897
Value of items that cannot be disclosed: Carbon dioxide, cement, clay (fire), fluorspar (except 1973), molybdenum, stone (dimension, 1972, 1974), vanadium, and values indicated by symbol W	XX	27,424	XX	29,403	XX	29,631	XX	77,755
Total	XX	1,046,285	XX	1,097,292	XX	r 1,306,590	XX	1,941,544
		NEW YORK						
Clays thousand short tons	[3]1,588	[3]1,742	[3]1,601	[3]1,919	[3]1,799	[3]2,146	[3]1,451	[3]2,348
Emery short tons	1,585	W	2,883	W	2,883	W	W	W
Gem stones	NA	15	NA	16	NA	16	NA	16
Gypsum thousand short tons	415	2,376	486	3,079	525	3,369	364	2,942
Lead (recoverable content of ores, etc.) short tons	877	242	1,089	327	2,304	751	3,076	1,384
Mercury 76-pound flasks	W	W	W	W	--	--	W	W
Natural gas million cubic feet	2,202	661	3,679	1,199	4,539	1,590	4,990	2,745
Peat thousand short tons	15	196	15	200	11	166	18	181
Petroleum (crude) thousand 42-gallon barrels	1,126	5,292	1,018	4,897	967	5,412	896	9,538
Salt thousand short tons	5,303	43,601	5,604	43,866	5,202	42,364	6,464	57,705
Sand and gravel do	23,221	28,328	26,722	36,952	29,544	41,396	30,614	46,652
Silver (recoverable content of ores, etc.) thousand troy ounces	18	28	25	42	54	129	64	304
Stone thousand short tons	37,778	73,418	38,138	77,825	44,393	94,693	38,207	87,724
Zinc (recoverable content of ores, etc.) short tons	63,420	20,421	60,749	21,566	81,455	33,657	93,077	66,829
Value of items that cannot be disclosed: Cement, clay (ball), garnet (abrasive), iron ore, lime, talc, titanium concentrate, wollastonite, and values indicated by symbol W	XX	122,963	XX	128,566	XX	150,167	XX	162,205
Total	**XX**	**299,288**	**XX**	**320,454**	**XX**	**375,866**	**XX**	**440,578**

See footnotes at end of table.

Table 6.—Mineral production[1] in the United States, by State—Continued

Mineral	1971 Quantity	1971 Value (thousands)	1972 Quantity	1972 Value (thousands)	1973 Quantity	1973 Value (thousands)	1974 Quantity	1974 Value (thousands)
NORTH CAROLINA								
Clays[3] ---- thousand short tons	3,503	$3,802	3,862	$4,473	4,109	$5,057	3,422	$4,648
Feldspar ---- short tons	393,811	4,681	439,838	6,030	523,595	8,820	650,684	11,147
Gem stones	NA	30	NA	32	NA	40	NA	50
Mica:								
Scrap ---- thousand short tons	67	1,770	91	2,942	106	4,423	76	3,679
Sheet ---- pounds	8,705	3	--	--	--	--	W	W
Sand and gravel ---- thousand short tons	14,240	14,690	12,823	13,812	15,897	19,327	12,784	20,844
Stone ---- do	30,917	58,026	32,297	62,741	38,782	80,065	34,762	75,142
Talc and pyrophyllite ---- short tons	85,289	522	89,334	594	95,833	1,094	110,978	993
Value of items that cannot be disclosed: Asbestos, cement, clay (kaolin), copper (1971), gold (1971), iron ore, lead (1971), lithium minerals, olivine, phosphate rock, silver (1971), tungsten (1971), zinc (1971), and values indicated by symbol W	XX	25,996	XX	24,896	XX	28,104	XX	39,366
Total	XX	109,520	XX	115,520	XX	146,930	XX	155,869
NORTH DAKOTA								
Coal (lignite) ---- thousand short tons	6,075	11,580	6,632	13,416	6,906	14,328	7,463	16,351
Gem stones	NA	2	NA	2	NA	2	NA	2
Natural gas ---- million cubic feet	33,864	5,655	32,472	5,455	27,703	5,457	31,206	6,210
Peat ---- short tons	W	W	--	--	--	--	240	W
Petroleum (crude) ---- thousand 42-gallon barrels	21,653	70,805	20,624	67,647	20,235	78,916	19,697	119,022
Sand and gravel ---- thousand short tons	8,196	6,210	6,681	5,757	6,011	6,021	4,991	6,211
Stone ---- do	W	W	--	--	W	W	35	115
Value of items that cannot be disclosed: Clays, lime, natural gas liquids, pumice (1972), salt, and values indicated by symbol W	XX	5,649	XX	5,809	XX	7,129	XX	11,516
Total	**XX**	**99,901**	**XX**	**98,086**	**XX**	**111,853**	**XX**	**159,427**
OHIO								
Cement:								
Masonry ---- thousand short tons	**142**	**3,811**	**161**	**4,684**	**176**	**5,641**	**158**	**5,227**
Portland ---- do	**2,897**	**54,338**	**2,968**	**57,953**	**3,456**	**73,362**	**2,884**	**73,815**
Clays ---- do	**3,973**	**11,380**	**4,125**	**11,278**	**4,732**	**12,456**	**4,325**	**13,488**
Coal (bituminous) ---- do	**51,431**	**269,601**	**50,967**	**303,819**	**45,788**	**338,792**	**45,409**	**559,519**
Gem stones	**NA**	**8**	**NA**	**8**	**NA**	**8**	**NA**	**8**
Lime ---- thousand short tons	**4,007**	**65,258**	**4,418**	**75,560**	**4,389**	**77,028**	**4,171**	**93,695**
Natural gas ---- million cubic feet	**79,903**	**27,007**	**89,995**	**35,271**	**93,610**	**39,786**	**97,055**	**44,371**
Peat ---- thousand short tons	**6**	**84**	**4**	**67**	**4**	**64**	**5**	**74**
Petroleum (crude) ---- thousand 42-gallon barrels	**8,286**	**29,801**	**9,358**	**35,179**	**8,796**	**44,690**	**9,088**	**89,348**
Salt ---- thousand short tons	**5,709**	**46,651**	**6,147**	**47,710**	**4,657**	**41,643**	**5,029**	**49,089**
Sand and gravel ---- do	**40,797**	**54,044**	**48,506**	**59,932**	**48,987**	**69,982**	**41,358**	**68,258**
Stone ---- do	**46,891**	**88,372**	**48,498**	**90,821**	**[4]55,107**	**[4]98,009**	**[4]51,709**	**[4]105,098**
Value of items that cannot be disclosed: Abrasive stone, gypsum, and stone (dimension, 1973–74)	**XX**	**1,796**	**XX**	**2,462**	**XX**	**5,518**	**XX**	**5,680**
Total	**XX**	**652,151**	**XX**	**724,748**	**XX**	**806,979**	**XX**	**1,107,670**

OKLAHOMA								
Clay ---- thousand short tons	[3]845	[3]1,255	[3]938	[3]1,398	[3]1,298	[3]1,871	1,289	2,105
Coal (bituminous) ---- do	2,234	15,004	2,624	19,112	2,183	16,779	2,356	24,759
Gypsum ---- do	1,022	3,073	1,196	3,888	1,429	5,796	1,225	5,622
Helium:								
High-purity ---- million cubic feet	123	4,305	176	6,160	181	6,335	169	5,915
Crude ---- do	270	3,240	163	1,956	115	1,380	134	1,608
Lead (recoverable content of ores, etc.) -- short tons	--	--	--	--	--	--	W	W
Natural gas ---- million cubic feet	1,684,260	273,945	1,806,887	294,523	1,770,980	334,110	1,638,942	458,904
Natural gas liquids:								
Natural gasoline and cycle products thousand 42-gallon barrels	14,197	40,856	14,559	42,709	14,674	49,070	12,581	84,638
LP gases ---- do	27,540	56,732	27,148	57,011	29,044	95,264	31,231	166,461
Petroleum (crude) ---- do	213,313	725,611	207,633	709,033	191,204	723,273	177,785	1,277,076
Pumice ---- thousand short tons	W	W	W	W	1	W	W	W
Salt ---- do	W	W	W	W	5	36	W	W
Sand and gravel ---- do	5,713	8,259	7,901	11,138	12,154	14,941	8,708	13,772
Stone ---- do	19,449	27,125	19,448	26,574	22,316	34,999	22,228	36,599
Zinc (recoverable content of ores, etc.) -- short tons	(5)	(5)	W	W	--	--	--	--
Value of items that cannot be disclosed: Cement, clay (bentonite, 1971-73), copper, feldspar (1974), lime, silver, tripoli, and values indicated by symbol W ----	XX	30,111	XX	37,296	XX	39,772	XX	46,231
Total ----	XX	1,189,516	XX	1,210,798	XX	1,323,626	XX	2,123,690
OREGON								
Clays ---- thousand short tons	157	255	151	238	168	291	140	243
Copper ---- short tons	3	3	W	W	W	W	W	W
Diatomite ---- do	70	1	W	W	W	W	W	W
Gem stones ----	NA	755	NA	793	NA	700	NA	500
Gold (recoverable content of ores, etc.) - troy ounces	244	10	W	W	W	W	W	W
Lead ---- short tons	--	--	--	--	--	--	W	W
Lime ---- thousand short tons	106	1,989	96	2,129	106	2,552	98	2,818
Mercury ---- 76-pound flasks	W	W	--	--	W	W	--	--
Nickel (content of ore and concentrate) -- short tons	17,036	W	16,864	W	18,272	W	16,618	W
Pumice ---- thousand short tons	943	1,389	W	W	[r] 1,171	[r] 2,013	915	1,887
Sand and gravel ---- do	20,230	28,707	24,489	34,981	22,802	32,751	18,558	30,948
Silver (recoverable content of ores, etc.) thousand troy ounces	**4**	**6**	**2**	**4**	**1**	**3**	**9**	**42**
Stone ---- thousand short tons	**13,794**	**26,708**	**10,915**	**18,380**	**13,411**	**21,843**	**23,353**	**43,406**
Value of items that cannot be disclosed: Cement, talc and soapstone, tungsten (1971-72), and values indicated by symbol W ----	**XX**	**18,212**	**XX**	**19,991**	**XX**	**21,424**	**XX**	**24,076**
Total ----	**XX**	**78,035**	**XX**	**76,516**	**XX**	**[r] 81,577**	**XX**	**103,920**
PENNSYLVANIA								
Cement:								
Masonry ---- thousand short tons	**559**	**11,247**	**451**	**12,401**	**490**	**14,443**	**404**	**14,642**
Portland ---- do	**7,850**	**140,460**	**8,214**	**156,008**	**8,563**	**171,653**	**7,448**	**191,594**
Clays ---- do	**[3]2,825**	**[3]8,940**	**2,682**	**15,829**	**[3]2,975**	**[3]16,664**	**[3]2,732**	**[3]16,496**
Coal:								
Anthracite ---- do	**8,727**	**103,469**	**7,106**	**85,251**	**6,830**	**90,260**	**6,617**	**144,695**

See footnotes at end of table.

Table 6.—Mineral production [1] in the United States, by State—Continued

Mineral	1971		1972		1973		1974	
	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)
PENNSYLVANIA—Continued								
Coal—Continued								
Bituminous thousand short tons	73,835	$620,196	75,939	$694,267	76,403	$786,792	80,462	$1,637,394
Copper (recoverable content of ores, etc.) short tons	3,349	3,483	2,611	2,673	1,845	2,195	--	--
Gem stones	NA	9	NA	9	NA	9	NA	9
Lime thousand short tons	1,760	30,008	1,891	33,802	2,260	40,949	2,080	50,147
Mica, scrap do	W	W	W	W	--	--	--	--
Natural gas million cubic feet	76,451	20,770	73,958	22,389	78,514	32,976	82,637	36,360
Peat thousand short tons	38	461	22	320	28	411	30	515
Petroleum (crude) thousand 42-gallon barrels	3,798	17,699	3,441	16,414	3,282	18,440	3,478	36,220
Sand and gravel thousand short tons	19,668	36,162	18,757	36,804	20,576	42,830	18,071	45,181
Stone do	64,467	118,469	67,307	124,340	78,564	150,346	73,092	159,615
Zinc (recoverable content of ores, etc.) short tons	27,438	8,835	18,344	6,512	18,857	7,792	20,288	14,567
Value of items that cannot be disclosed: Clay (kaolin except 1972), cobalt (1971), gold (1971), iron ore, natural gas liquids, pyrites (1971), silver (1971), tripoli, and values indicated by symbol W	XX	28,899	XX	24,466	XX	26,140	XX	27,077
Total	XX	1,149,107	XX	1,231,485	XX	1,401,900	XX	2,374,512
RHODE ISLAND								
Sand and gravel thousand short tons	2,252	3,052	2,079	3,336	2,429	3,095	2,784	4,605
Stone do	3	422	[4] 329	[4] 23	W	W	W	W
Value of items that cannot be disclosed: Other nonmetals and values indicated by symbol W	XX	825	XX	932	XX	1,245	XX	1,377
Total	XX	4,299	XX	4,291	XX	4,340	XX	5,982
SOUTH CAROLINA								
Clays thousand short tons	[3] 2,049	[3] 10,201	2,221	11,268	[3] 2,250	[3] 12,877	[3] 2,297	[3] 13,765
Gem stones	--	--	--	--	NA	5	NA	5
Mica (scrap) thousand short tons	W	W	W	W	W	W	W	252
Peat do	W	W	W	W	14	W	18	W
Sand and gravel do	6,438	9,119	7,916	12,121	8,179	12,628	7,380	13,054
Stone do	11,047	17,852	12,482	21,819	14,985	24,280	12,242	21,719
Value of items that cannot be disclosed: Cement, clays (selected, except 1972), feldspar (1971–72) vermiculite, and values indicated by symbol W	XX	29,716	XX	37,105	XX	38,571	XX	56,376
Total	XX	66,888	XX	82,313	XX	88,361	XX	105,171
SOUTH DAKOTA								
Clays [3] thousand short tons	150	128	185	156	201	181	190	202
Feldspar short tons	24,640	539	25,000	400	W	W	W	W
Gem stones	NA	40	NA	42	NA	42	NA	42
Gold (recoverable content of ores, etc.) troy ounces	513,427	21,179	407,430	23,875	375,575	34,974	343,723	54,906
Gypsum thousand short tons	21	83	24	43	W	W	32	135
Lime do	W	W	W	W	63	1,206	94	2,059
Mica (scrap) do	W	W	W	W	--	--	W	W

Petroleum (crude) thousand 42-gallon barrels	233	604	219	574	275	988	494	3,283
Sand and gravel thousand short tons	16,727	18,392	12,748	14,793	13,963	16,587	9,028	9,720
Silver (recoverable content of ores, etc.) thousand troy ounces	107	165	100	168	72	184	62	294
Stone thousand short tons	2,199	8,874	2,665	10,864	2,745	11,607	2,968	14,231
Value of items that cannot be disclosed: Beryllium concentrate (1971–72), cement, clays (bentonite), uranium (1971–72), vanadium (1972), and values indicated by symbol W	XX	12,984	XX	14,535	XX	15,370	XX	17,755
Total	XX	62,988	XX	65,450	XX	81,139	XX	102,627
		TENNESSEE						
Barite thousand short tons	21	342	W	W	W	W	W	W
Cement:								
Masonry do	159	3,649	176	4,104	201	7,908	154	4,706
Portland do	1,713	33,733	1,695	37,176	1,711	42,402	1,525	43,339
Clays [3] do	1,537	6,595	1,718	7,719	1,719	9,083	1,638	9,776
Coal (bituminous) do	9,271	59,368	11,260	81,386	8,219	66,827	7,541	135,874
Copper (recoverable content of ores, etc.) short tons	13,916	14,473	11,310	11,581	8,500	10,115	6,304	9,745
Gold (recoverable content of ores, etc.) troy ounces	192	8	176	10	68	7	18	3
Lime thousand short tons	W	W	W	W	W	W	136	3,449
Natural gas million cubic feet	89	20	25	8	20	6	17	6
Petroleum (crude) thousand 42-gallon barrels	398	W	198	W	201	W	769	7,256
Phosphate rock thousand short tons	2,571	12,151	2,154	10,732	2,512	12,799	2,411	18,465
Sand and gravel do	8,018	11,845	10,839	15,328	12,010	20,145	10,702	19,476
Silver (recoverable content of ores, etc.) thousand troy ounces	131	203	83	141	73	187	20	94
Stone thousand short tons	32,369	48,665	35,942	55,512	42,742	71,116	41,720	75,547
Zinc (recoverable content of ores, etc.) short tons	119,295	38,413	101,722	36,111	64,172	26,516	85,671	61,512
Value of items that cannot be disclosed: Clay (fuller's earth), pyrites, and values indicated by symbol W	XX	10,197	XX	10,006	XX	8,579	XX	6,360
Total	XX	239,662	XX	269,814	XX	275,690	XX	395,608
		TEXAS						
Cement:								
Masonry thousand short tons	169	4,514	217	5,812	234	6,606	195	6,438
Portland do	7,198	140,206	7,813	171,642	8,320	189,368	7,739	207,706
Clays do	4,615	10,432	5,175	11,554	5,667	13,115	5,315	13,677
Coal (lignite) do	W	W	4,045	W	6,944	W	7,684	W
Gem stones	NA	155	NA	163	NA	163	NA	160
Gypsum thousand short tons	1,308	4,806	1,542	5,284	1,616	6,469	1,365	5,276
Helium:								
Crude million cubic feet	1,208	14,496	1,026	12,312	904	10,848	35	420
High-purity do	50	1,750	--	--	--	--	--	--
Lime thousand short tons	1,612	24,583	1,631	22,181	1,677	26,887	1,835	39,644
Natural gas million cubic feet	8,550,705	1,376,664	8,657,840	1,419,886	8,513,850	1,735,221	8,170,798	2,541,118
Natural gas liquids:								
Natural gasoline and cycle products thousand 42-gallon barrels	96,286	299,981	92,437	294,163	92,743	347,398	88,316	629,529
LP gases do	210,435	380,887	226,624	428,319	221,686	589,685	213,756	1,004,653

See footnotes at end of table.

Table 6.—Mineral production [1] in the United States, by State—Continued

Mineral	1971 Quantity	1971 Value (thousands)	1972 Quantity	1972 Value (thousands)	1973 Quantity	1973 Value (thousands)	1974 Quantity	1974 Value (thousands)
TEXAS—Continued								
Perlite short tons	--	--	2,391	$24	602	W	--	--
Petroleum (crude) thousand 42-gallon barrels	1,222,926	$4,261,775	1,301,685	4,536,077	1,294,671	$5,157,623	1,262,126	$8,773,003
Pumice thousand short tons	4	4	W	W	--	--	--	--
Salt do	9,217	40,838	9,744	35,544	10,354	45,350	11,379	51,296
Sand and gravel do	32,788	51,814	35,151	56,328	38,546	60,706	42,466	81,364
Stone do	41,168	[4]62,144	49,314	[4]66,573	62,574	91,379	[4]63,074	[4]109,758
Sulfur (Frasch process) thousand long tons	3,092	W	3,847	W	4,109	W	W	W
Talc and soapstone short tons	193,830	1,024	221,022	1,262	232,514	1,246	188,262	1,310
Value of items that cannot be disclosed: Asphalt (native), fluorspar (1972–74), graphite, iron ore, magnesium chloride (for metal), magnesium compounds (except for metal), mercury, sodium sulfate, stone (dimension, except 1973), uranium, and values indicated by symbol W	XX	132,210	XX	143,427	XX	160,435	XX	245,792
Total	XX	6,808,283	XX	7,211,551	XX	8,442,494	XX	13,711,144
UTAH								
Carbon dioxide, natural thousand cubic feet	55,178	4	61,103	4	80,490	6	93,751	6
Clays thousand short tons	198	1,064	[3]266	[3]790	[3]243	[3]771	232	953
Coal (bituminous) do	4,626	34,082	4,802	42,868	5,500	61,566	5,858	71,699
Copper (recoverable content of ores, etc.) short tons	263,451	273,989	259,507	265,735	256,589	305,341	230,593	356,497
Fluorspar do	10,947	341	2,977	84	4,778	144	2,967	98
Gem stones	NA	90	NA	95	NA	95	NA	100
Gold (recoverable content of ores, etc.) troy ounces	368,996	15,221	362,413	21,237	307,080	30,035	254,909	40,719
Gypsum thousand short tons	W	W	W	W	231	1,134	248	1,076
Iron ore (usable) thousand long tons, gross weight	1,681	11,886	1,788	W	1,986	13,581	1,808	14,016
Lead (recoverable content of ores, etc.) short tons	38,270	10,562	20,706	6,224	13,733	4,474	10,510	4,729
Lime thousand short tons	172	3,569	171	4,216	185	3,804	176	4,911
Manganiferous ore (5% to 35% Mn) short tons	112	W	--	--	--	--	--	--
Natural gas million cubic feet	42,418	7,084	39,474	6,711	42,715	8,159	50,522	20,815
Natural gas liquids:								
Natural gasoline and cycle products thousand 42-gallon barrels	W	W	458	1,406	W	W	W	W
LP gases do	W	W	1,742	2,787	W	W	W	W
Petroleum (crude) do	23,630	71,886	26,570	80,778	32,656	117,743	39,368	279,858
Pumice thousand short tons	6	10	14	29	42	57	15	19
Salt do	614	5,213	660	4,955	717	6,913	771	7,321
Sand and gravel do	10,505	10,190	14,619	17,071	15,410	15,986	11,578	12,985
Silver (recoverable content of ores, etc.) thousand troy ounces	5,294	8,185	4,300	7,245	3,619	9,257	3,208	15,109
Stone thousand short tons	2,556	5,335	3,384	6,005	2,848	6,318	2,869	6,410
Uranium (recoverable content (U_3O_8)) thousand pounds	1,445	8,959	1,496	9,425	[r]1,961	[r]12,745	W	W
Vanadium (recoverable in ore and concentrate) short tons	226	W	188	W	142	W	W	W

Zinc (recoverable content of ores, etc.) do	25,701	8,276	21,853	7,758	16,800	6,942	12,619	9,060
Value of items that cannot be disclosed: Asphalt (gilsonite), beryl concentrate, cement, clays (kaolin, 1972–73), magnesium chloride (1972–73), magnesium compounds, molybdenum, phosphate rock, potassium salts, sodium sulfate, tungsten, and values indicated by symbol W	XX	49,754	XX	57,391	XX	70,408	XX	105,664
Total	XX	525,700	XX	542,809	XX	r 675,479	XX	952,045
VERMONT								
Peat thousand short tons	W	W	(5)	1	(5)	2	(5)	4
Sand and gravel do	3,761	3,518	3,302	3,214	4,041	3,581	2,394	3,588
Stone do	2,496	27,940	3,300	26,170	1,871	19,523	1,932	21,630
Talc short tons	W	W	180,239	1,326	251,087	1,497	W	W
Value of items that cannot be disclosed: Asbestos, clays, gem stones, and values indicated by symbol W	XX	4,631	XX	4,157	XX	4,763	XX	10,231
Total	XX	36,089	XX	34,868	XX	29,366	XX	35,453
VIRGINIA								
Clays thousand short tons	1,710	1,800	1,634	1,783	1,646	1,886	1,957	2,614
Coal (bituminous) do	30,628	254,870	34,028	344,061	33,961	377,679	34,326	856,099
Gem stones	NA	12	NA	13	NA	13	NA	13
Lead (recoverable content of ores, etc.) short tons	3,386	934	3,441	1,034	2,637	859	3,106	1,398
Lime thousand short tons	759	11,049	758	11,739	782	12,205	895	18,929
Natural gas million cubic feet	2,619	822	2,787	892	5,101	1,688	7,096	3,619
Petroleum (crude) thousand 42-gallon barrels	1	W	(5)	(5)	--	--	3	W
Sand and gravel thousand short tons	12,796	20,201	14,085	21,696	14,511	26,246	14,314	29,270
Soapstone short tons	3,704	8	W	W	4,600	12	W	W
Stone thousand short tons	34,643	63,482	39,986	74,090	43,895	82,719	44,176	95,988
Zinc (recoverable content of ores, etc.) short tons	16,829	5,419	16,789	5,960	16,683	6,894	17,195	12,346
Value of items that cannot be disclosed: Aplite, cement, feldspar (1971), gypsum, kyanite, salt (1971-72), titanium concentrate (1971), and values indicated by symbol W	XX	26,564	XX	28,523	XX	r 35,201	XX	37,931
Total	XX	385,161	XX	489,791	XX	r 545,402	XX	1,058,207
WASHINGTON								
Cement:								
Masonry thousand short tons	5	145	6	170	6	169	6	193
Portland do	1,149	23,735	1,239	26,848	1,194	26,651	1,377	36,347
Clays [3] do	255	549	264	584	287	664	269	698
Coal (bituminous) do	1,134	7,614	2,635	17,424	3,270	21,440	W	W
Gem stones	NA	155	NA	163	NA	160	NA	160
Gypsum thousand short tons	W	W	5	13	W	W	W	W
Lead (recoverable content of ores, etc.) short tons	5,117	1,429	2,567	772	2,217	722	1,299	585
Peat thousand short tons	17	72	18	89	21	110	14	85
Pumice do	W	W	W	W	1	1	(5)	1
Sand and gravel do	22,702	26,658	23,065	26,069	27,935	30,132	22,842	35,030
Silver (recoverable content of ores, etc.) thousand troy ounces	W	W	221	372	W	W	W	W

See footnotes at end of table.

Table 6.—Mineral production [1] in the United States, by State—Continued

Mineral	1971		1972		1973		1974	
	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)
WASHINGTON—Continued								
Stone ---- thousand short tons --	**12,436**	**$20,489**	**14,712**	**[4] $28,764**	**11,384**	**$19,284**	**15,095**	**$24,488**
Zinc (recoverable content of ores, etc.) -- short tons --	**5,782**	**1,862**	**6,483**	**2,301**	**6,378**	**2,635**	**6,909**	**4,960**
Values of items that cannot be disclosed: Abrasives (1971), clays (fire), copper, diatomite, gold, lime, olivine, stone (dimension, 1972), talc, tungsten (1972–74), uranium, and values indicated by symbol W ----	XX	11,893	XX	11,237	XX	r 12,695	XX	41,374
Total ----	XX	94,601	XX	109,806	XX	r 114,663	XX	143,916
WEST VIRGINIA								
Clays [3] ---- thousand short tons --	232	336	274	403	348	516	339	520
Coal (bituminous) ---- do ----	118,258	1,128,282	123,743	1,275,813	115,448	1,340,338	102,462	2,218,418
Gem stones ----	NA	2	NA	2	NA	2	NA	2
Lime ---- thousand short tons --	197	3,073	W	W	W	W	128	2,315
Natural gas ---- million cubic feet --	234,027	60,613	214,951	64,485	208,676	64,481	202,306	66,356
Petroleum (crude) ---- thousand 42-gallon barrels --	2,969	11,609	2,677	12,047	2,385	11,965	2,665	27,058
Salt ---- thousand short tons --	1,174	4,778	1,232	5,963	1,217	6,082	1,201	6,296
Sand and gravel ---- do ----	7,107	16,756	5,765	15,031	5,893	16,257	5,382	16,018
Stone ---- do ----	[4] 9,880	[4] 18,066	[4] 11,649	[4] 21,293	[4] 11,732	[4] 22,821	10,954	22,308
Value of items that cannot be disclosed: Cement, clays (fire), natural gas liquids, stone (dimension, 1971–73), and values indicated by symbol W ----	XX	30,445	XX	35,595	XX	40,583	XX	43,836
Total ----	XX	1,273,960	XX	1,430,632	XX	1,503,045	XX	2,403,177
WISCONSIN								
Clays ---- thousand short tons --	4	8	4	7	2	3	2	4
Gem stones ----	NA	W	NA	1	NA	1	NA	1
Iron ore (usable) -- thousand long tons, gross weight --	824	W	887	W	956	W	899	W
Lead (recoverable content of ores, etc.) -- short tons --	752	207	757	228	844	275	1,285	578
Lime ---- thousand short tons --	246	4,570	263	5,009	310	6,004	311	6,764
Peat ---- do ----	2	153	2	179	2	208	6	290
Sand and gravel ---- do ----	38,561	32,748	36,430	31,324	40,250	43,647	28,850	34,577
Stone ---- do ----	15,568	25,105	19,394	29,681	23,818	36,917	22,443	40,912
Zinc (recoverable content of ores, etc.) -- short tons --	10,645	3,428	6,873	2,440	8,672	3,583	8,737	6,273
Value of items that cannot be disclosed: Abrasive stones, cement, copper (1974), and values indicated by symbol W ----	XX	17,817	XX	20,484	XX	23,701	XX	25,364
Total ----	XX	84,036	XX	89,353	XX	114,339	XX	114,763
WYOMING								
Clays ---- thousand short tons --	1,798	17,378	1,873	18,509	2,343	24,043	2,511	29,339
Coal (bituminous) ---- do ----	8,052	27,335	10,928	40,898	14,886	60,939	20,703	103,915
Feldspar ---- short tons --	W	W	W	W	2,588	56	W	W
Gem stones ----	NA	135	NA	142	NA	142	NA	140
Gypsum ---- thousand short tons --	232	918	W	W	312	1,348	315	960

Iron ore (usable) ... thousand long tons, gross weight	1,808	W	2,030	W	2,070	W	2,105	W
Lime ... thousand short tons	27	W	W	W	30	548	29	464
Natural gas ... million cubic feet	380,105	58,156	375,059	60,760	357,731	64,749	326,657	80,081
Natural gas liquids:								
Natural gasoline ... thousand 42-gallon barrels	2,514	7,415	3,015	8,951	3,351	10,647	2,933	18,577
LP gases ... do	5,474	10,127	7,691	15,536	7,237	22,507	6,804	31,707
Petroleum (crude) ... do	148,114	459,079	140,011	432,071	141,914	541,820	139,997	914,860
Sand and gravel ... thousand short tons	9,820	8,750	9,098	14,916	6,201	11,635	5,532	9,508
Stone ... do	2,894	4,789	3,549	5,768	3,191	6,716	2,384	[4]5,989
Uranium (recoverable content U_3O_8) thousand pounds	6,986	43,311	8,544	58,827	r 10,134	r 65,868	7,449	78,218
Value of items that cannot be disclosed: Cement, phosphate rock, pumice (1972–73), sodium carbonate, and values indicated by symbol W	XX	80,544	XX	95,865	XX	117,565	XX	168,997
Total	XX	717,987	XX	746,743	XX	r 928,583	XX	1,437,200

r Revised. NA Not available. W Withheld to avoid disclosing individual company confidential data. XX Not applicable.

[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

[2] Excludes certain cement, included with "Value of items that cannot be disclosed."

[3] Excludes certain clays, included with "Value of items that cannot be disclosed."

[4] Excludes certain stones, included with "Value of items that cannot be disclosed."

[6] Total of items listed.

[7] Excludes salt in brine, included with "Value of items that cannot be disclosed."

Table 7.—Mineral production[1] in the islands administered by the United States

Area and mineral	1971		1972		1973		1974	
	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)
American Samoa:								
Pumice thousand short tons	10	$35	--	--	37	$214	27	$183
Stone do	33	30	49	$414	63	152	50	122
Total	XX	65	XX	414	XX	366	XX	305
Guam: Stone thousand short tons	718	1,705	831	1,983	1,246	3,139	798	1,444
Virgin Islands:								
Stone do	543	W	726	2,255	664	2,860	638	3,869
Wake: Stone do	3	16	--	--	--	--	--	--

XX Not applicable.

W Withheld to avoid disclosing individual company confidential data.

[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

Table 8.—Mineral production[1] in the Commonwealth of Puerto Rico

(Thousand short tons and thousand dollars)

Mineral	1971		1972		1973		1974	
	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value
Cement	2,001	38,413	1,946	31,756	2,062	41,203	1,881	70,277
Clays	342	358	361	382	464	473	291	332
Lime	44	W	42	1,776	42	2,215	39	2,928
Salt	29	570	29	580	29	580	29	624
Sand and gravel	12,998	34,980	7,478	21,237	7,480	21,243	NA	NA
Stone	12,130	29,847	13,504	32,793	15,647	41,857	14,362	41,640
Total	XX	[2]104,168	XX	88,524	XX	107,571	XX	[2]115,796

NA Not available. W Withheld to avoid disclosing individual company confidential data.

XX Not applicable.

[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

[2] Total does not include value of items withheld or not available.

Table 9.—U.S. exports of principal minerals and products[1]

Mineral	1973		1974	
	Quantity	Value (thousands)	Quantity	Value (thousands)
METALS				
Aluminum:				
Ingots, slabs, crude short tons	229,578	$121,951	207,834	$155,817
Scrap do	115,120	39,936	80,159	33,043
Plates, sheets, bars, etc do	202,371	178,482	216,080	247,976
Castings and forgings do	5,277	14,613	5,933	19,623
Aluminum sulfate do	21,134	642	41,875	1,807
Other aluminum compounds do	836,659	92,643	816,293	109,063
Antimony, metals and alloys, crude do	515	469	871	1,572
Bauxite, including bauxite concentrates thousand long tons	12	811	16	1,218
Beryllium pounds	109,199	1,220	143,628	1,107
Bismuth, metals and alloys do	151,053	446	329,926	1,520
Boron:				
Boric acid short tons	41,407	6,862	35,740	8,774
Sodium borates, refined do	168,826	19,354	218,107	33,836
Cadmium thousands pounds	305	598	62	238
Calcium:				
Carbonite short tons	11,445	1,088	11,073	1,541
Chloride do	96,897	2,225	30,866	1,700
Dicalcium phosphate do	35,969	4,753	29,196	6,864
Chrome:				
Ore and concentrates:				
Exports thousand short tons	21	789	18	1,430
Reexports do	34	989	99	3,101
Ferrochrome do	15	5,091	7	3,765
Cobalt thousand pounds	3,890	8,932	3,679	10,979
Columbium metals, alloys, other forms do	96	790	83	563
Copper:				
Ore, concentrate, composition metal and unrefined (copper content) short tons	45,957	[r] 48,512	30,216	28,819
Scrap do	42,286	38,675	41,342	46,413
Refined copper and semimanufactures do	242,856	386,993	202,203	448,584
Other copper manufactures do	7,431	12,160	8,332	17,583
Copper sulfate or blue vitriol do	1,716	2,043	1,815	2,138
Copper-base alloys do	149,888	205,249	169,521	284,839
Ferroalloys:				
Ferrosilicon do	15,984	4,051	6,576	3,338
Ferrophosphorus do	19,030	773	3,677	408
Gold:				
Ore and base bullion troy ounces	334,255	26,692	308,081	49,410
Bullion, refined do	2,650,962	116,273	3,555,193	179,070
Iron ore thousand long tons	2,747	37,922	2,823	35,148
Iron and steel:				
Pig iron short tons	15,160	882	100,582	6,743
Iron and steel products (major):				
Semimanufactures do	3,317,118	713,292	4,757,828	1,373,496
Manufactured steel mill products do	1,644,412	867,594	2,230,287	1,636,698
Iron and steel scrap: Ferrous scrap, including rerolling materials thousand short tons	11,412	606,556	9,023	881,885
Lead:				
Pigs, bars, anodes, sheets, etc. short tons	66,576	27,097	61,982	32,685
Scrap do	[r] 59,851	[r] 12,222	59,366	16,813
Magnesium, metal and alloys, scrap, semimanufactured forms, n.e.c do	39,585	28,242	46,398	48,511
Manganese:				
Ore and concentrate do	57,448	4,585	223,088	13,656
Ferromanganese do	8,574	2,137	7,011	2,204
Metal do	4,660	3,109	2,318	2,119
Mercury, exports 76-pound flasks	342	170	466	270
Molybdenum:				
Ore and concentrates (molybdenum content) thousand pounds	73,958	120,387	78,660	151,075
Metals and alloys, crude and scrap do	148	252	105	256
Wire do	357	3,105	415	4,210
Semifabricated forms, n.e.c do	209	1,216	251	1,670
Powder do	195	672	203	728
Ferromolybdenum do	2,224	3,151	4,094	7,094

See footnotes at end of table.

Table 9.—U.S. exports of principal minerals and products [1]—Continued

Mineral	1973		1974	
	Quantity	Value (thousands)	Quantity	Value (thousands)
METALS—Continued				
Nickel:				
Alloys and scrap (including Monel metal), ingots, bars, sheets, etc short tons	16,545	$50,712	22,355	$94,980
Catalysts do	2,478	6,584	3,477	9,143
Nickel-chrome electric resistance wire do	697	3,818	1,117	6,056
Semifabricated forms, n.e.c do	2,350	14,689	3,493	23,319
Platinum:				
Ore, concentrate, metal and alloys in ingots, bars, sheets, anodes, other forms, including scrap troy ounces	439,452	61,379	474,494	78,142
Palladium, rhodium, iridium, osmiridium, ruthenium, and osmium (metal and alloys including scrap) do	188,074	16,246	361,260	39,279
Platinum-group manufactures, except jewelry	NA	4,282	NA	3,753
Rare-earth metals, including cerium ore, metal, alloys, lighter flints pounds	109,766	286	192,144	503
Silicon:				
Ferrosilicon short tons	15,984	4,051	6,575	3,338
Silicon carbide, crude and in grains do	7,723	3,413	14,112	5,813
Silver:				
Ore, concentrates, waste, sweepings thousand troy ounces	3,007	7,322	12,699	53,956
Bullion, refined do	8,208	20,316	5,691	27,695
Tantalum:				
Ore, metal, other forms thousand pounds	360	3,962	704	6,813
Powder do	202	5,312	233	7,008
Tin:				
Ingots, pigs, bars, etc.:				
Exports long tons	2,540	12,099	5,908	47,774
Reexports do	866	3,236	2,507	15,700
Tin scrap and other tin-bearing material except tinplate scrap do	4,862	3,262	7,325	5,950
Titanium:				
Ore and concentrate short tons	1,494	353	3,264	727
Sponge (including iodide titanium and scrap) do	4,142	3,601	4,730	9,288
Intermediate mill shapes and mill products, n.e.c do	745	8,748	1,719	19,600
Dioxide and pigments do	20,769	14,021	30,540	24,696
Tungsten, ore and concentrates:				
Exports thousand pounds	90	239	1,187	4,835
Reexports do	--	--	88	292
Uranium:				
Ores and concentrates (U_3O_8 content) pounds	109,934	737	--	--
Metal do	14,737	270	20,496	322
Compounds do	4,028,095	26,107	4,682,926	30,855
Isotopes (stable) and their compounds	NA	17,041	NA	2,786
Radioactive materials thousand curies	15,615,135	12,303	25,431,262	16,571
Special nuclear materials	NA	223,516	NA	158,267
Vanadium: Ore and concentrate, pentoxide, etc. (vanadium content) pounds	464,399	1,157	406,235	1,327
Ferrovanadium do	2,832,762	8,734	2,670,321	7,863
Zinc:				
Slabs, pigs, or blocks short tons	14,566	8,259	19,062	16,511
Sheets, plates, strips, other forms n.e.c do	2,480	2,100	3,487	3,842
Waste, scrap, and dust (zinc content) do	7,032	2,717	12,088	6,280
Semifabricated forms, n.e.c do	15,077	10,565	28,456	27,343
Zirconium:				
Ore and concentrate pounds	57,842,328	2,288	42,973,250	3,323
Metals, alloys, other forms do	1,016,437	12,425	1,650,695	18,195

See footnotes at end of table.

Table 9.—U.S. exports of principal minerals and products [1]—Continued

Mineral	1973		1974	
	Quantity	Value (thousands)	Quantity	Value (thousands)
NONMETALS				
Abrasives:				
Dust and powder of precious or semiprecious stones, including diamond dust and powder ---------- thousand carats --	9,928	$25,071	14,005	$34,822
Crushing bort ---------- do ----	40	138	11	25
Industrial diamonds ---------- do ----	516	4,208	981	5,460
Diamond grinding wheels ---------- do ----	746	4,223	894	5,574
Other natural and artificial metallic abrasives and products ----------	NA	49,329	NA	69,627
Asbestos:				
Exports:				
Unmanufactured ---------- short tons --	65,900	9,251	55,114	8,643
Products ---------- do ----	NA	40,705	NA	60,256
Reexports:				
Unmanufactured ---------- do ----	542	91	6,609	549
Products ---------- do ----	NA	72	NA	140
Barite:				
Natural barium sulfate ---------- do ----	68,086	2,884	61,245	2,518
Lithopone ---------- do ----	986	357	1,185	967
Boron: Boric acid, and borates, crude and refined ---------- do ----	210,233	26,216	253,847	42,610
Cement ---------- do ----	324,740	8,980	289,844	14,860
Clays:				
Kaolin or china clay ---------- do ----	781,798	30,528	848,878	42,080
Fire clay ---------- do ----	196,337	3,820	224,110	5,988
Other clays ---------- do ----	1,168,495	45,426	1,376,888	66,148
Feldspar, leucite, nepheline, nepheline syenite ---------- thousand pounds --	19,107	466	36,688	662
Fluorspar ---------- short tons --	[r] 2,428	[r] 171	5,847	316
Gem stones:				
Diamonds ---------- thousand carats --	259	314,172	284	404,639
Pearls ----------	NA	473	NA	817
Other ----------	NA	21,770	NA	19,625
Graphite ---------- short tons --	7,958	992	12,189	1,698
Gypsum:				
Crude, crushed or calcined thousand short tons --	68	3,135	132	3,910
Manufactures, n.e.c ----------	NA	4,225	NA	6,934
Lithium hydroxide ---------- thousand pounds --	1,043	605	1,198	1,118
Kyanite and allied minerals ---------- short tons --	98,714	5,552	135,982	8,205
Lime ---------- do ----	36,914	1,208	31,639	1,516
Magnesium compounds:				
Magnesite, dead-burned thousand pounds --	101,520	6,104	102,533	7,749
Magnesite, crude, caustic calcined, lump, or ground ---------- do ----	18,608	4,196	21,465	5,088
Mica sheet, waste and scrap, and ground ---------- pounds --	14,588,464	2,201	16,842,858	3,085
Mica, manufactured ---------- do ----	1,155,852	3,064	1,053,980	3,430
Mineral-earth pigments, iron oxide, natural and manufactured ---------- short tons --	14,363	6,702	15,585	9,437
Nitrogen compounds (major) thousand short tons --	[r] 4,539	[r] 317,591	3,751	565,649
Phosphate rock ---------- do ----	13,932	113,295	14,174	256,697
Phosphatic fertilizers:				
Superphosphates ---------- do ----	967	70,990	1,179	222,711
Ammonium phosphates ---------- do ----	2,235	189,064	1,992	358,807
Elemental phosphorus ---------- do ----	26,679	12,256	33,653	20,075
Mixed chemical fertilizer ---------- do ----	375	34,084	474	58,476
Pigments and compounds (lead and zinc):				
Lead pigments ---------- short tons --	2,240	1,025	3,395	1,926
Zinc pigments ---------- do ----	[r] 8,062	[r] 2,440	13,430	7,405
Potash:				
Fertilizer ---------- do ----	1,578,716	57,997	1,414,598	66,175
Chemical ---------- do ----	39,229	10,660	38,290	14,712
Pumice and pumicite ---------- thousand pounds --	6,190	765	5,821	1,211
Quartz, natural, quartzite, cryolite, chiolite ---------- do ----	724	134	3,002	808
Salt:				
Crude and refined -- thousand short tons --	609	4,400	521	4,276
Shipments to noncontiguous territories ---------- do ----	[r] 20	[r] 1,820	19	1,798

See footnotes at end of table.

Table 9.—U.S. exports of principal minerals and products [1]—Continued

Mineral	1973 Quantity	1973 Value (thousands)	1974 Quantity	1974 Value (thousands)
NONMETALS—Continued				
Sand and gravel:				
Sand:				
Construction .... short tons	422,483	$793	658,801	$1,132
Industrial .... do	845,359	7,136	1,123,954	9,864
Gravel .... do	475,894	667	472,896	663
Sodium and sodium compounds:				
Sodium sulfate .... do	45	2,049	51	3,250
Sodium carbonate .... do	425	16,064	564	34,156
Stone:				
Dolomite, block .... do	59	652	86	1,559
Limestone, crushed, ground broken do	2,316	5,400	2,793	7,753
Marble and other building and monumental .... thousand cubic feet	NA	1,244	NA	1,920
Stone, crushed, ground, broken thousand short tons	765	4,819	625	4,850
Manufactures of stone	NA	948	NA	2,077
Sulfur:				
Crude .... thousand long tons	1,771	34,830	2,580	95,516
Crushed, ground, flowers .... do	r 5	1,461	21	1,829
Talc, crude and ground .... short tons	180,102	6,618	182,706	6,711
MINERAL FUELS				
Carbon black .... thousand pounds	192,665	24,056	201,737	32,947
Coal:				
Anthracite .... thousand short tons	717	11,240	735	16,577
Bituminous .... do	r 52,870	1,002,457	59,926	2,420,334
Briquets .... do	92	5,107	113	6,729
Coke .... do	1,395	33,138	1,278	43,564
Natural gas .... thousand cubic feet	84,805,211	43,152	107,873,053	68,676
Petroleum:				
Crude .... thousand barrels	697	2,620	1,072	13,565
Gasoline .... do	1,692	20,737	655	12,105
Jet fuel .... do	824	4,087	655	7,637
Naphtha .... do	1,561	19,671	1,293	27,211
Kerosine .... do	81	811	33	525
Distillate fuel oil .... do	2,526	25,680	307	5,518
Residual fuel oil .... do	8,388	23,578	4,261	41,232
Lubricating oil .... do	10,728	173,546	11,297	321,951
Asphalt .... do	338	3,262	341	5,238
Liquefied petroleum gases .... do	9,927	57,191	9,033	94,464
Wax .... do	942	24,176	862	34,464
Coke .... do	34,668	127,182	40,790	181,171
Petrochemical feedstocks .... do	6,815	32,500	5,558	65,712
Miscellaneous .... do	1,168	27,886	1,194	44,433
Total	XX	7,539,909	XX	12,733,090

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r Revised. NA Not available. XX Not applicable.

[1] Due to additions of commodities and changes in classifications, data not strictly comparable to earlier years.

Table 10.—U.S. imports for consumption of principal minerals and products[1]

Mineral	1973		1974	
	Quantity	Value (thousands)	Quantity	Value (thousands)
METALS				
Aluminum:				
Metal ---- short tons --	[r] 508,184	[r] $225,545	508,648	$312,479
Scrap ---- do ----	[r] 46,824	[r] 16,754	74,748	42,569
Plates, sheets, bars, etc ---- do ----	[r] 58,794	[r] 48,255	46,081	47,489
Aluminum oxide (alumina) ---- do ----	[r] 3,406,689	[r] 211,288	3,627,024	270,617
Antimony:				
Ore (antimony content) ---- do ----	16,679	10,903	14,655	20,866
Needle or liquated ---- do ----	51	73	86	271
Metal ---- do ----	692	745	2,203	7,550
Oxide ---- do ----	4,651	6,095	6,269	15,580
Arsenic:				
White (As_2O_3 content) ---- do ----	[r] 13,496	[r] 2,045	13,742	2,449
Metallic ---- do ----	648	2,630	707	3,651
Bauxite, crude ---- thousand long tons --	[r] [2] 12,778	NA	[2] 14,308	NA
Beryllium ore ---- short tons --	1,586	481	1,368	414
Bismuth ---- pounds --	[r] 2,683,671	[r] 9,688	1,898,744	15,606
Boron:				
Carbide ---- do ----	322,236	395	75,429	265
Boric acid ---- do ----	20,161	3	844,811	149
Calcium borate, crude ---- do ----	36,431,521	568	42,427,527	852
Cadmium:				
Metal ---- short tons --	[r] 1,948	[r] 12,963	1,985	14,674
Flue dust (cadmium content) ---- do ----	[r] 174	[r] 611	166	603
Calcium:				
Metal ---- pounds --	110,407	78	109,252	121
Chloride ---- short tons --	7,357	317	3,599	156
Chromate:				
Ore and concentrates (Cr_2O_3 content) thousand short tons --	412	21,028	481	28,532
Ferrochrome ---- do ----	[r] 105	[r] 37,198	102	55,261
Metal ---- do ----	3	6,080	2	5,388
Cobalt:				
Metal ---- thousand pounds --	[r] 18,398	[r] 53,772	14,791	49,661
Oxide (gross weight) ---- do ----	1,150	2,714	1,509	4,514
Salts and compounds (gross weight) do ----	62	51	2	12
Columbium ore ---- do ----	2,826	2,201	3,129	3,207
Copper (copper content):				
Ore and concentrates ---- short tons --	19,582	16,029	84,981	180,269
Regulus, black, coarse ---- do ----	139	106	2,426	12,033
Unrefined, black, blister ---- do ----	128,166	159,922	200,607	383,491
Refined in ingots, etc ---- do ----	[r] 207,739	[r] 264,967	313,349	551,442
Old and scrap ---- do ----	[r] 18,981	[r] 23,540	31,109	50,640
Ferroalloys, n.e.c ---- do ----	62,520	21,297	81,668	87,848
Gallium ---- kilograms --	11,124	6,073	6,536	4,107
Gold:				
Ore and base bullion ---- troy ounces --	[r] 234,694	19,388	329,357	45,974
Bullion ---- do ----	3,610,073	336,762	2,321,981	350,706
Indium ---- do ----	811,527	986	492,978	1,906
Iron ore ---- thousand long tons --	43,296	533,488	48,029	696,298
Iron and steel:				
Pig iron ---- short tons --	445,626	28,925	342,348	41,038
Iron and steel products (major):				
Iron products ---- do ----	38,048	19,118	49,524	29,328
Steel products ---- do ----	[r] 15,569,833	3,026,099	16,696,508	5,553,379
Scrap ---- do ----	336,693	18,716	188,480	26,166
Tinplate ---- do ----	11,940	384	12,645	861
Lead:				
Ore, flue dust, matte (lead content) do ----	[r] 94,299	[r] 17,882	62,691	15,180
Base bullion (lead content) ---- do ----	4	1	831	331
Pigs and bars (lead content) ---- do ----	[r] 178,116	[r] 52,937	118,367	57,693
Reclaimed scrap, etc. (lead content) do ----	[r] 3,116	[r] 588	1,286	334
Sheet, pipe and shot ---- do ----	[r] 772	[r] 308	196	138
Magnesium:				
Metallic and scrap ---- do ----	[r] 2,916	[r] 1,437	4,815	3,518
Alloys (magnesium content) ---- do ----	389	1,104	440	1,578
Sheets, tubing, ribbons, wire, other forms (magnesium content) ---- do ----	20	129	50	185
Manganese:				
Ore (35% or more manganese) -- do ----	722,685	37,403	592,818	45,091
Ferromanganese (manganese content) ---- do ----	[r] 303,885	[r] 53,337	327,874	88,426
Metal ---- do ----	2,452	1,100	2,506	1,379

See footnotes at end of table.

Table 10.—U.S. imports for consumption of principal minerals and products[1]—Continued

Mineral	1973 Quantity	1973 Value (thousands)	1974 Quantity	1974 Value (thousands)
METALS—Continued				
Mercury:				
Compounds ---- pounds --	3,543	$30	62,807	$153
Metal ---- 76-pound flasks --	46,026	12,151	52,180	13,948
Minor metals, selenium and salts --- pounds --	590,173	6,023	841,259	10,611
Molybdenum:				
Ore (metal content) ---- do ----	458,315	963	155,125	217
Waste and scrap ---- do ----	94,961	197	100,159	218
Metal ---- do ----	34,626	366	53,947	574
Compounds ---- do ----	2,270,433	2,083	1,456,055	1,515
Nickel:				
Pigs, ingots, shot, cathodes -- short tons --	120,083	343,494	137,314	450,342
Plates, bars, etc ---- do ----	1,628	7,708	1,310	7,446
Slurry ---- do ----	38,749	81,851	42,999	96,959
Scrap ---- do ----	2,642	3,906	3,699	8,545
Powder and flakes ---- do ----	7,291	23,067	9,371	33,545
Ferronickel ---- do ----	89,780	70,532	102,430	87,255
Oxide ---- do ----	6,301	13,466	6,449	15,081
Platinum-group metals:				
Unwrought:				
Grains and nuggets (platinum) troy ounces --	19,146	2,396	71,154	18,626
Sponge (platinum) ---- do ----	499,271	73,108	833,122	150,563
Sweepings, waste and scrap -- do ----	84,534	10,229	129,320	18,116
Iridium ---- do ----	19,701	4,816	28,980	9,482
Palladium ---- do ----	496,065	36,613	588,014	74,483
Rhodium ---- do ----	72,856	15,587	97,058	39,957
Ruthenium ---- do ----	67,218	3,375	63,884	3,678
Other platinum-group metals -- do ----	243,584	33,877	234,789	45,337
Semimanufactured:				
Platinum ---- do ----	155,715	22,949	199,355	35,388
Palladium ---- do ----	658,240	43,500	750,073	75,553
Rhodium ---- do ----	20,355	1,761	1,549	898
Other platinum-group metals -- do ----	3,806	621	7,821	1,335
Radium: Radioactive substitutes ----	NA	[r] 5,603	NA	7,565
Rare-earth metals, ferrocerium and other cerium alloys ---- pounds --	38,206	127	57,519	238
Silicon (silicon content):				
Metal ---- short tons --	8,302	11,955	5,914	16,700
Ferrosilicon ---- do ----	[r] 63,724	[r] 21,316	92,951	66,350
Silver (general imports):				
Ore and base bullion thousand troy ounces --	33,990	74,927	34,568	150,284
Bullion ---- do ----	[r] 81,373	[r] 215,897	89,963	432,868
Sweepings, waste, dore ---- do ----	15,472	39,832	8,864	40,642
Tantalum ore ---- thousand pounds --	1,097	2,858	1,897	7,169
Tin:				
Ore (tin content) ---- long tons --	[r] 4,798	[r] 18,511	5,877	35,999
Blocks, pigs, grains, etc ---- do ----	45,845	195,246	39,602	289,592
Dross, skimmings, scrap, residues and alloys, n.s.p.f ---- do ----	1,281	1,322	1,761	1,186
Tin foil, powder, flitters, etc ----	NA	6,956	NA	9,331
Titanium:				
Ilmenite[3] ---- short tons --	[r] [3] 306,939	[r] [3] 11,856	[3] 318,720	[3] 13,715
Rutile ---- do ----	[2] 208,808	[3] 27,158	[2] 235,507	[3] 37,445
Metal ---- pounds --	13,648,385	11,389	20,090,390	19,546
Ferrotitanium ---- do ----	512,547	178	4,592,316	3,122
Compounds and mixtures ---- do ----	121,789,426	28,057	70,866,757	25,216
Tungsten (tungsten content):				
Ore and concentrates -- thousand pounds --	[r] 10,884	[r] 23,725	11,096	40,696
Waste and scrap ---- do ----	102	309	179	711
Other alloys ---- do ----	1,433	4,947	2,462	9,368
Ferrotungsten ---- do ----	1,107	3,105	808	3,029
Uranium and other uranium-bearing and nuclear materials:				
Oxide U_3O_8 ---- pounds --	11,210,066	61,442	3,670,678	30,284
Compounds, n.e.c ---- do ----	10,914,684	82,860	12,866,822	90,921
Isotopes (stable) and their compounds ----	NA	808	NA	1,007
Radio isotopes, elements, etc. thousand curies --	34,672,001	5,537	24,246,498	7,565
Vanadium (content):				
Ore ---- thousand pounds --	57	37	--	--
Ferrovanadium ---- do ----	393	1,174	288	1,142
Vanadium-bearing materials (vanadium pentoxide content)[4] ----	XX	XX	7,744	5,566

See footnotes at end of table.

Table 10.—U.S. imports for consumption of principal minerals and products [1]—Continued

Mineral	1973		1974	
	Quantity	Value (thousands)	Quantity	Value (thousands)
METALS—Continued				
Zinc:				
Ore (zinc content) ---------- short tons --	r 154,174	r $24,708	133,733	$31,430
Blocks, pigs, slabs ---------------- do ----	r 590,751	r 278,623	543,806	431,250
Sheets, etc ---------------------- do ----	236	159	640	568
Old, dross, skimmings ------------ do ----	r 2,328	r 506	3,868	1,786
Dust, powder, flakes -------------- do ----	4,873	2,468	9,131	9,799
Manufactures ----------------------------	NA	r 608	NA	563
Zirconium:				
Ore, including zirconium sand ---- do ----	98,023	5,415	62,504	6,398
Wrought, scrap, compounds ------ do ----	2,137	3,394	2,702	4,865
NONMETALS				
Abrasives:				
Diamonds (industrial) - thousand carats --	r 19,166	r 65,713	18,413	62,920
Other abrasives -------------------------	NA	70,942	NA	80,054
Asbestos ---------------------- short tons --	792,473	98,914	766,164	123,822
Barite:				
Crude and ground ---------------- do ----	r 724,807	7,767	764,625	9,155
Witherite ------------------------ do ----	4,611	716	3,435	710
Chemicals ------------------------ do ----	32,780	6,719	43,383	13,033
Cement ---------------- thousand short tons	r 6,686	r 104,128	5,732	101,784
Clays:				
Raw ---------------------- short tons --	46,044	1,303	37,012	1,778
Manufactured ------------------- do ----	r 6,905	r 677	5,806	415
Cryolite ----------------------------- do ----	[2]19,789	[2]5,052	21,216	6,969
Feldspar:				
Crude -------------------------long tons --	264	22	30	(5)
Ground and crushed ------------- do ----	103	4	62	3
Fluorspar --------------------- short tons --	1,212,347	52,620	1,336,389	60,988
Gem stones:				
Diamond ------------- thousand carats --	[2]5,181	r [2]821,185	4,533	760,040
Emeralds ------------------------ do ----	r 750	r 32,865	871	34,046
Other ----------------------------------	NA	88,968	NA	88,284
Graphite --------------------- short tons --	r 77,431	r 4,494	82,636	5,677
Gypsum:				
Crude, ground, calcined thousand short tons --	7,663	17,695	7,426	17,709
Manufactures ----------------------------	NA	4,242	NA	4,180
Iodine, crude ------------ thousand pounds --	r 6,149	r 10,585	7,970	14,849
Kyanite ---------------------- short tons --	221	13	194	12
Lime:				
Hydrated ------------------------ do ----	47,309	941	48,284	1,311
Other ---------------------------- do ----	286,703	4,302	367,917	6,368
Lithium:				
Ore ------------------------------- do ----	6,073	432	3,165	323
Compounds ----------------------- do ----	11	82	84	249
Magnesium compounds:				
Crude magnesite ------------ short tons --	--	--	19	1
Lump, ground, caustic calcined magnesia --------------------- do ----	10,967	734	8,990	692
Refractory magnesia, dead-burned fused magnesite, dead-burned dolomite - do ----	r 158,224	r 13,911	156,401	18,455
Compounds ----------------------- do ----	57,029	1,880	32,064	2,107
Mica:				
Uncut sheet and punch thousand pounds --	1,169	1,269	794	947
Scrap ----------------------------- do ----	5,072	116	6,634	193
Manufactures -------------------- do ----	4,785	4,325	6,555	4,928
Mineral-earth pigments, iron oxide pigments:				
Ocher, crude and refined ---- short tons --	66	9	53	10
Siennas, crude and refined -------- do ----	1,192	205	1,309	264
Umber, crude and refined -------- do ----	9,665	569	7,790	565
Vandyke brown ------------------ do ----	966	144	958	183
Natural, other -------------------- do ----	1,858	378	2,162	376
Synthetic ------------------------- do ----	37,436	10,700	41,948	14,969
Nepheline syenite:				
Crude ------------------------------ do ----	258	4	4,605	79
Ground, crushed, etc -------------- do ----	473,838	6,022	505,028	7,558
Nitrogen compounds (major), including urea --------------- thousand short tons --	r 2,842	r 146,667	3,374	345,230
Phosphate, crude ---------------------- do ----	[2]65	[2]1,288	[2]182	[2]8,999
Phosphatic fertilizers ------------------ do ----	r 182	r 11,889	202	32,512

See footnotes at end of table.

Table 10.—U.S. imports for consumption of principal minerals and products [1]—Continued

Mineral	1973		1974	
	Quantity	Value (thousands)	Quantity	Value (thousands)
NONMETALS—Continued				
Pigments and salts:				
Lead pigments and compounds short tons	20,515	$8,602	14,884	$10,001
Zinc pigments and compounds do	r 36,802	14,071	89,436	26,048
Potash do	r 6,064,812	r 157,057	7,265,222	256,082
Pumice:				
Crude or unmanufactured do	5,026	95	8,415	228
Wholly or partly manufactured do	305,400	1,038	284,505	1,214
Manufactures, n.s.p.f	NA	19	NA	80
Quartz crystal (Brazilian pebble) pounds	1,064,774	364	1,781,913	624
Salt thousand short tons	r 8,207	r 12,554	3,358	14,428
Sand and gravel:				
Glass sand do	48	340	51	486
Other sand and gravel do	752	1,236	843	352
Sodium sulfate do	320	5,658	375	10,382
Stone and whiting	NA	48,678	NA	51,631
Strontium: Mineral short tons	27,040	657	38,431	1,145
Compounds do	5,822	1,724	8,547	3,095
Sulfur and compounds, ore and other forms, n.e.s thousand long tons	1,222	r 14,871	2,150	51,124
Talc: Unmanufactured short tons	22,993	1,658	30,252	2,288
MINERAL FUELS				
Carbon black:				
Acetylene pounds	7,268,499	2,080	7,749,624	2,814
Gas black and carbon black do	8,669,196	991	29,615,297	4,829
Coal:				
Bituminous, slack, culm, lignite short tons	126,641	1,607	2,080,407	57,781
Briquets do	7,425	128	48,238	888
Coke do	1,077,737	39,268	3,540,826	193,165
Natural gas, ethane, methane, and mixtures thereof thousand cubic feet	r 1,015,524,282	r 846,197	967,116,185	508,277
Peat:				
Fertilizer grade short tons	817,639	18,390	828,268	22,816
Poultry and stable grade do	5,862	372	3,267	266
Petroleum:				
Crude petroleum thousand barrels	r 1,297,616	r 4,240,225	1,362,458	15,252,724
Distillate fuel oil do	r 191,364	r 726,845	83,038	995,549
Residual fuel oil do	r 557,015	r 1,707,459	499,914	5,037,761
Unfinished oils do	r 3,270	r 35,385	13,866	172,189
Gasoline do	17,330	139,528	33,903	570,829
Jet fuel do	r 78,089	r 325,549	56,667	649,685
Motor fuels, n.e.s do	r 1,335	r 7,852	955	10,907
Kerosine do	1,078	6,946	1,028	20,354
Lubricants do	r 129	r 2,204	411	6,983
Wax do	r 382	r 8,993	352	11,257
Naphtha do	r 99,311	r 841,407	88,275	1,181,872
Liquefied petroleum gases do	r 48,076	r 152,547	45,091	365,028
Asphalt do	r 8,943	r 21,147	12,209	64,144
Miscellaneous do	r 13,394	r 51,928	19,353	159,768
Total	XX	17,332,775	XX	39,556,497

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r Revised. NA Not available. XX Not applicable.

[1] Due to additions of commodities and changes in classifications, data are not strictly comparable to earlier years.

[2] Data adjusted by the Bureau of Mines.

[3] Includes titanium slag averaging about 70% TiO.

[4] Classification established Jan. 1, 1974.

[5] Less than ½ unit.

Table 11.—Comparison of world and U.S. production of principal mineral commodities

(Thousand short tons unless otherwise specified)

Minerals	1973 World production [1]	1973 U.S. production	1973 U.S. percent of world production	1974 [p] World production [1]	1974 [p] U.S. production	1974 [p] U.S. percent of world production
MINERAL FUELS						
Carbon black ---------- million pounds --	7,819	3,500	45	7,916	3,390	43
Coal:						
Bituminous	[2]2,305,572	577,574	25	[2]2,327,860	587,928	25
Lignite	903,852	14,164	2	918,099	15,478	2
Pennsylvania anthracite	194,404	6,830	4	206,258	6,617	3
Coke (excluding breeze):						
Gashouse [3]	9,183	--	--	8,964	--	--
Oven and beehive	400,742	64,325	16	408,741	61,581	15
Natural gas (marketable) ---------- million cubic feet --	46,139,070	22,647,549	49	47,137,672	21,600,522	46
Peat	230,172	635	(4)	220,344	781	(4)
Petroleum (crude) ---------- thousand barrels --	20,367,981	3,360,903	17	20,537,727	3,202,585	16
NONMETALS						
Asbestos	4,512	150	3	4,536	118	3
Barite	4,673	1,104	24	4,789	1,106	23
Cement	733,061	[5]87,578	11	776,210	[5]82,888	11
Clay, china	16,886	[6]5,993	36	17,715	[6]6,393	36
Corundum	9	--	--	9	--	--
Diamond ---------- thousand carats --	43,140	--	--	44,085	--	--
Diatomite	1,790	609	34	1,876	664	35
Feldspar	2,993	792	27	3,174	854	27
Fluorspar	5,044	249	5	5,082	201	4
Graphite	409	W	NA	432	W	NA
Gypsum	67,858	13,558	20	66,109	11,999	18
Lime (sold or used)	118,197	[5]21,132	18	121,640	[5]21,645	18
Magnesite	9,994	W	NA	10,195	W	NA
Mica (including scrap) ---------- thousand pounds --	546,284	306,684	56	520,946	273,932	53
Nitrogen, agricultural [7]	41,802	[5]9,296	22	45,037	[5]10,088	22
Phosphate rock	108,858	42,137	39	121,601	45,686	38
Potash (K_2O equivalent)	24,298	2,603	11	26,068	2,552	10
Pumice [8]	16,396	3,974	24	14,422	3,964	28
Pyrites ---------- thousand long tons --	23,190	559	2	23,368	424	2
Salt	166,611	[5]43,940	26	172,228	[5]46,423	27
Strontium [8]	103	--	--	108	--	--
Sulfur, elemental ---------- thousand long tons --	48,410	10,921	23	50,861	11,419	22
Talc, pyrophyllite, soapstone	5,808	1,247	21	6,028	1,268	21
Vermiculite [3]	549	365	67	554	341	62
METALS, MINE BASIS						
Antimony (content of ore and concentrate) ---------- short tons --	76,744	545	1	77,751	661	1
Arsenic, white ---------- do --	50,978	W	NA	54,764	W	NA
Bauxite ---------- thousand long tons --	68,821	[9]1,879	3	76,989	[9]1,949	3
Beryl ---------- short tons --	3,963	W	NA	3,977	W	NA
Bismuth ---------- thousand pounds --	8,296	W	NA	8,556	W	NA
Chromite	7,414	--	--	7,931	--	--
Cobalt (contained) ---------- short tons --	29,268	--	--	33,504	--	--

See footnotes at end of table.

Table 11.—Comparison of world and U.S. production of principal mineral commodities—Continued

(Thousand short tons unless otherwise specified)

Minerals	1973 World production [1]	1973 U.S. production	1973 U.S. percent of world production	1974 [p] World production [1]	1974 [p] U.S. production	1974 [p] U.S. percent of world production
METALS, MINE BASIS—Continued						
Columbium-tantalum concentrate [8] ____ thousand pounds __	53,799	--	--	53,103	--	--
Copper (content of ore and concentrate) ____	7,848	[10] 1,718	22	8,105	[10] 1,594	20
Gold ____ thousand troy ounces __	42,998	1,176	3	39,780	1,127	3
Iron ore ____ thousand long tons __	836,442	[11] 87,669	10	879,414	[11] 84,355	10
Lead (content of ore and concentrate) ____	3,878	[10] 609	16	3,845	[10] 664	17
Manganese ore (35% or more Mn) ____	24,568	([4])	([4])	24,175	--	--
Mercury ____ thousand 76-pound flasks __	268	2	1	262	2	1
Molybdenum (content of ore and concentrate) _ thousand pounds __	184,122	155,859	63	188,274	112,011	60
Nickel (content of ore and concentrate) ____	757	18	2	826	17	2
Platinum-group metals ____ thousand troy ounces __	5,239,781	19,980	([4])	5,759,822	12,657	([4])
Silver ____ do ____	308,584	37,484	12	295,562	33,762	11
Tin (content of ore and concentrate) ____ long tons __	232,358	W	NA	227,642	W	NA
Titanium concentrates:						
Ilmenite [8] ____	2,978	776	26	3,149	745	24
Rutile [8] ____	374	9	2	369	6	2
Tungsten concentrate (contained tungsten) __ thousand pounds __	84,150	7,575	9	82,357	7,381	9
Uranium oxide (U_3O_8) [8] ____ short tons __	25,635	13,235	52	24,176	11,528	48
Vanadium (content of ore and concentrate) ____ do ____	21,633	4,377	20	22,149	4,870	22
Zinc (content of ore and concentrate) ____	6,297	479	8	6,384	500	8
METALS, SMELTER BASIS						
Aluminum ____	13,393	4,529	34	14,517	4,903	34
Cadmium ____ short tons __	18,884	[12] 3,751	20	18,780	[12] 3,333	18
Copper ____	7,932	[13] 1,744	22	8,148	[13] 1,570	19
Iron, pig ____	552,157	101,317	18	566,534	95,477	17
Lead ____	3,796	[14] 688	18	3,821	[14] 684	18
Magnesium ____	266	122	46	W	W	NA
Selenium [8] ____ thousand pounds __	2,626	796	30	2,621	644	25
Steel ingots and castings ____	766,839	[15] 150,799	20	779,349	[15] 145,720	19
Tellurium [8] ____ thousand pounds __	446	241	54	362	191	53
Tin ____ long tons __	228,336	[16] 4,800	2	225,501	[16] 6,000	3
Zinc ____	5,848	583	10	5,968	555	9

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[p] Preliminary. NA Not available.

W Withheld to avoid disclosing individual company confidential data.

[1] May not represent total world production because confidential U.S. data are excluded for some commodities. World totals include reported figures and reasonable estimates; however, for some commodities where data were not available, no reasonable estimates could be made and none have been included.

[2] Includes small quantities of lignite for People's Republic of China and Pakistan, and anthracite for Colombia.

[3] Includes low- and medium-temperature and gashouse coke.

[4] Less than ½ unit.

[5] Includes Puerto Rico.

[6] Kaolin sold or used by producers.

[7] Year ended June 30 of year stated (United Nations).

[8] World total exclusive of the U.S.S.R.

[9] Dry bauxite equivalent of crude ore.

[10] Recoverable.

[11] Includes byproduct ore.

[12] Includes secondary.

[13] Smelter output from domestic and foreign ores, exclusive of scrap.

[14] Lead refined from domestic and foreign ores; excludes lead refined from imported base bullion.

[15] Data from American Iron and Steel Institute. Excludes production of castings by companies that do not produce steel ingot.

[16] Includes tin content of alloys made directly from ore.

Abrasive Materials

By Robert G. Clarke [1]

The overall output of natural abrasives, excluding emery, decreased 14% in quantity and 5% in value compared with 1973. Tripoli-type crudes decreased in both quantity and value. Special silica stone products decreased slightly in quantity but showed an increase in value. The sales of garnet were the highest in its history for both quantity and value. Emery production was down 13% in quantity.

The overall production of artificial abrasives increased 13% in quantity and 61% in value. Silicon carbide production remained essentially unchanged in quantity, but the value increased. For all other artificial abrasives the increase in production was well over that of 1973 in both quantity and value.

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[1] Physical scientist, Division of Nonmetallic Minerals.

Table 1.—Salient abrasive statistics in the United States

Kind	1970	1971	1972	1973	1974
Natural abrasives (domestic) sold or used by producers:					
Tripoli (crude) short tons	68,105	75,184	87,864	101,519	81,721
Value thousands	$520	$569	$797	$929	$516
Special silica-stone products [1] short tons	3,184	2,349	3,241	3,466	3,184
Value thousands	$665	$568	$670	$677	$717
Garnet short tons	18,837	18,984	18,916	22,772	24,684
Value thousands	$1,936	$1,984	$1,957	$2,380	$2,551
Emery short tons	W	1,586	2,883	2,884	2,520
Value thousands	W	W	W	W	W
Artificial abrasives [2] short tons	561,107	472,299	584,680	[3] 645,813	[3] 730,018
Value thousands	$85,772	$79,027	$92,958	[3] $108,308	[3] $175,678
Foreign trade (natural and artificial abrasives):					
Exports (value) do	$64,338	$60,685	$64,219	$82,969	$115,508
Reexports (value) do	$28,085	$21,711	$26,746	$29,413	$29,793
Imports for consumption (value) do	$96,467	$89,085	$106,512	$136,655	$142,974

W Withheld to avoid disclosing individual company confidential data.

[1] Includes grinding pebbles, grindstones, oilstones, tube-mill liners, and whetstones.

[2] Production of silicon carbide and aluminum oxide (United States and Canada); shipments of metallic abrasives (United States).

[3] Includes production of aluminum zirconium oxide (United States and Canada.).

FOREIGN TRADE

Imports of abrasive materials were 5% more in value than in 1973, and exports plus reexports increased 29%. Net exports, the excess of exports, and reexports over imports, were $2.3 million, the first occurrence of net exports historically for abrasive materials. The volume, as well as the unit values, of most abrasive materials exported and reexported increased.

The major influence on the total value of trade continued to be industrial diamond. Industrial diamond imports totaled 18.4 million carats of loose material valued at $62.9 million, a decrease of 4% in both quantity and value from that of 1973. The exports of industrial diamond, loose, amounted to 15.0 million carats, an increase of 43%, and the value was $40.3 million, an increase of 37%. Reexports of similar industrial diamond amounted to 3.7 million carats, a decrease of 18%, and the value was $29.6 million, an increase of 1%. The diamond content in diamond wheels, exported and reexported, amounted to 901,000 carats, an increase of 20%, the declared value was $5.6 million, an increase of 33%. The imports of diamond wheels are listed by number and value; the value in 1974 decreased to $971,000 from $1,037,000 in 1973.

The 1974 receipts of industrial diamond from Ireland were 8.3 million carats, valued at $18.7 million, reflecting a decrease of 13% in quantity and 12% in value from those of 1973. The share of imports provided by Ireland was 45% of the total quantity and 30% of value. Of the industrial diamond listed as powder or dust, synthetic diamond was 4.6 million carats valued at $9.3 million, and natural diamond was 7.2 million carats valued at $15.2 million.

Table 2.—U.S. exports of abrasive materials, by kind
(Thousands)

Kind	1973		1974	
	Quantity	Value	Quantity	Value
NATURAL ABRASIVES				
Dust and powder of natural and synthetic precious or semiprecious stones, including diamond dust and powder ------- carats --	9,923	$25,071	14,005	$34,822
Crushing bort, except dust and powder ------------------------ do ----	40	138	11	25
Industrial diamond ---------------- do ----	516	4,208	981	5,460
Emery, natural corundum, and other natural abrasives, n.e.c ---------------- pounds --	35,625	3,979	39,784	5,746
MANUFACTURED ABRASIVES				
Artificial corundum (fused aluminum oxide) --------------------------- do ----	59,157	11,470	64,632	14,893
Silicon carbide, crude or in grains --- do ----	15,445	3,413	27,224	5,813
Carbide abrasives, n.e.c ------------ do ----	1,964	4,006	1,748	4,905
Grinding and polishing wheels and stones:				
Diamond ---------------------- carats --	746	4,223	894	5,574
Pulpstones ------------------- pounds --	2,450	833	3,315	1,130
Polishing stones, whetstones, oilstones, hones, and similar stones ----- do ----	787	1,050	1,261	1,624
Wheels and stones, n.e.c -------- do ----	5,204	9,776	5,551	12,523
Abrasive paper and cloth, coated with natural or artificial abrasive materials -- reams --	360	12,067	528	19,844
Coated abrasives, n.e.c --------------------	NA	2,735	NA	3,144
Total --------------------------------	XX	82,969	XX	115,503

NA Not available. XX Not applicable.

Table 3.—U.S. reexports of abrasive materials, by kind

(Thousands)

Kind	1973		1974	
	Quantity	Value	Quantity	Value
NATURAL ABRASIVES				
Dust and powder of natural and synthetic precious or semiprecious stones, including diamond dust and powder .... carats ..	488	$1,206	369	$1,010
Crushing bort except dust and powder .... do	418	2,372	465	3,302
Industrial diamond .... do	3,578	25,596	2,856	25,274
Emery, natural corundum, and other natural abrasives, n.e.c .... pounds ..	167	39	4	100
MANUFACTURED ABRASIVES				
Carbide abrasives .... do	(1)	9	(1)	3
Grinding and polishing wheels and stones:				
Diamond .... carats ..	r 2	9	7	40
Polishing stones, whetstones, oilstones, hones, and similar stones .. pounds ..	1	3	--	--
Wheels and stones, n.e.c .... do	108	132	18	14
Abrasive paper and cloth, coated with natural or artificial abrasive materials .. reams ..	(1)	(1)	(1)	1
Coated abrasives, n.e.c	NA	47	NA	49
Total	XX	29,413	XX	29,793

r Revised. NA Not available. XX Not applicable.

[1] Less than ½ unit.

Table 4.—U.S. imports for consumption of abrasive materials (natural and artificial), by kind

(Thousands)

Kind	1973		1974	
	Quantity	Value	Quantity	Value
Corundum, crude .... short tons ..	1	$34	2	$158
Emery, flint, rottenstone, and tripoli, crude or crushed .... do	13	408	17	843
Silicon carbide, crude .... do	113	16,762	98	15,720
Aluminum oxide, crude .... do	183	29,190	204	33,599
Other crude artificial abrasives .... do	r 2	210	4	676
Abrasives, ground grains, pulverized or refined:				
Rottenstone and tripoli .... do	--	--	(1)	1
Silicon carbide .... do	4	1,510	3	2,080
Aluminum oxide .... do	7	2,156	9	3,197
Emery, corundum, flint, garnet, and other, including artificial abrasives .... do	(1)	166	1	256
Papers, cloths, and other materials wholly or partly coated with natural or artificial abrasives	(2)	14,682	(2)	17,496
Hones, whetstones, oilstones, and polishing stones .... number ..	367	118	243	106
Abrasive wheels and millstones:				
Burrstones manufactured or bound up into millstones .... short tons ..	(1)	4	(1)	2
Solid natural stone wheels .. number ..	9	17	1	15
Diamond .... do	93	1,037	64	971
Other	(2)	3,698	(2)	3,514
Articles not especially provided for:				
Emery or garnet	(2)	51	(2)	15
Natural corundum or artificial abrasive materials	(2)	267	(2)	412
Other	(2)	242	(2)	296
Diamond:				
Diamond dies .... number ..	13	395	19	697
Crushing bort .... carats ..	74	166	144	365
Other industrial diamond .... do	r 5,562	r 34,485	5,080	31,210
Miners' diamond .... do	973	4,650	1,825	6,888
Dust and powder .... do	r 12,557	r 26,412	11,869	24,462
Total	XX	r 136,655	XX	142,974

r Revised. XX Not applicable.

[1] Less than ½ unit.

[2] Quantity not reported.

TRIPOLI

Although different in some respects, fine-grained, porous, silica materials are discussed as a group because they have similar properties and end uses. Commercially, the term "tripoli" is applied to material from Arkansas, Missouri, and Oklahoma; and the term "amorphous" or "soft" silica is applied to the material from the southern Illinois area. Rottenstone mined in Pennsylvania is more earthy, but its properties render it suitable for end uses similar to those of tripoli and amorphous silica. Production of crude tripoli (table 1) decreased 20% in quantity and 44% in value. Processed tripoli sold or used (table 5) decreased 4% in quantity but increased 6% in value. The uses for processed tripoli in 1974 were 59% for abrasives and 39% for fillers compared with 62% and 36%, respectively, in 1973.

Tripoli producers in 1973 were Malvern Minerals Company, Garland County, Ark., which produced crude and finished material, and The Carborundum Co., which produced crude in Ottawa County, Okla., and finished material in Newton County, Mo. Illinois Minerals Co. and Tammsco, Inc., both in Alexander County, Ill., produced amorphous silica. Keystone Filler and Manufacturing Co., in Lycoming County, Pa., mined and processed rottenstone. The major use of amorphous silica and rottenstone was for abrasive purposes; the minor use was as a filler.

Prices quoted in Engineering and Mining Journal, December 1974, for tripoli and amorphous silica were as follows:

Tripoli, paper bags, carload lots, f.o.b., in cents per pound:	
White, Elco, Ill.: Air floated through 200 mesh	1.4
Rose and cream, Seneca, Mo. and Rogers, Ark:	
Once ground	2.90
Double ground	2.90
Air float	3.15
Amorphous silica, bags, f.o.b., in dollars per ton:	
Elco, Ill.:	
Through 200 mesh, 90% to 95%	$28
Through 200 mesh, 96% to 99%	29
Through 325 mesh, 90% to 95%	30
Through 325 mesh, 96% to 98%	32.50
Through 325 mesh, 98% to 99.4%	34
Through 325 mesh, 99.5%	48.50
Through 400 mesh, 99.9%	71
Below 15 micrometers, 99%	78.50
Below 10 micrometers, 99%	100
Dierks, Ark.:	
200 mesh	30
325 mesh	40

Table 5.—Processed tripoli [1] sold or used by producers in the United States, by use [2]

Kind		1970	1971	1972	1973	1974
Abrasives	short tons	41,703	44,899	47,321	55,420	50,615
Value	thousands	$1,583	$1,692	$1,918	$2,233	$2,251
Filler	short tons	18,093	20,457	25,973	32,407	33,361
Value	thousands	$545	$681	r $847	$1,158	$1,346
Other	short tons	1,134	1,327	1,584	2,105	2,025
Value	thousands	$28	$32	$43	$62	$66
Total	short tons	60,930	66,683	74,878	89,932	86,000
Value [3]	thousands	$2,156	$2,406	$2,807	$3,453	$3,665

[1] Includes amorphous silica and Pennsylvania rottenstone.
[2] Partly estimated.
[3] Data may not add to totals shown because of independent rounding.

SPECIAL SILICA STONE PRODUCTS

Special silica stone products include the following: Oilstones from Arkansas, whetstones from Arkansas and Indiana, grindstones from Ohio, grinding pebbles and deburring media from Minnesota and Wisconsin, and tube-mill liners from Minnesota. Although the output decreased about 10%, the value increased 6%.

Producers of oilstones and whetstones in Garland County, Ark., were John O. Glassford, Hiram A. Smith, Cleve Milroy, Arkansas Abrasives, Inc., and Norton Pike Division of Norton Co. In Lawrence County, Ind., Hindostan Whetstone Co. operated a plant to finish its stone obtained from a quarry in Orange County, Ind. Cleveland Quarries Co. produced grindstones at its Amherst quarry, Lorain County, Ohio. Jasper Stone Co. produced grinding pebbles and tube-mill liners from its quarry in Rock County, Minn., and Baraboo Quartzite Co., Inc., produced deburring media at its quarry in Sauk County, Wis.

Table 6.—Special silica-stone products sold or used in the United States[1]

Year	Quantity (short tons)	Value (thousands)
1970	3,184	$665
1971	2,849	563
1972	3,241	670
1973	3,466	677
1974	3,184	717

[1] Includes grinding pebbles, grindstones, oilstones, tube-mill liners, and whetstones.

NATURAL SILICATE ABRASIVES

Garnet.—Sales of domestic garnet were at an alltime high in 1974; the quantity sold increased 8% and the value increased 7% over the respective quantity and value in 1973. Crushing, grinding, and screening were the customary processing for standard sizes and grits used in coated abrasives and in loose abrasive applications. To meet specifications for some special end uses, additional sophisticated treatments were applied to the grain. There were three active producers—two in Idaho and one in New York. Barton Mines Corp., Warren County, N.Y., was the largest producer and sold its garnet for use in coated abrasives, glass grinding and polishing, and metal lapping. Emerald Creek Garnet Milling Co., and Idaho Garnet Abrasive Co. produced garnet from placer deposits in Benewah County, Idaho. The Idaho producers reported their garnet was used in sandblasting, water filtration, as a filler in rubber products, and for miscellaneous abrasive lapping applications.

Average of prices for New York garnet, f.o.b. North Creek, N.Y., 2,000-pound release, in 330- to 370-pound containers were as follows, in cents per pound:

Untreated for manufacturing of coated abrasives:	
Grades 16 through 36	18
Grades 40 through 220	20
Grades 240 through 280	23
Grades 320 through 600	25
Untreated for technical grinding and lapping:	
Mesh sizes 20 to 240	15
Mesh sizes 280 to 360	20
Micrometer sizes 27 to 23	22
Micrometer sizes 20 to 8	25
Micrometer sizes 6 to 5	19
Micrometer sizes 4 to 2	34

Prices for Idaho garnet, f.o.b. Seattle, ranged from 5.5 to 10 cents per pound.

Table 7.—Abrasive garnet sold or used by producers in the United States

Year	Quantity (short tons)	Value (thousands)
1970	18,837	$1,936
1971	18,934	1,934
1972	18,916	1,957
1973	22,772	2,380
1974	24,684	2,551

NATURAL ALUMINA ABRASIVES

Corundum.—Domestic production of abrasive-grade corundum on a commercial scale was last reported in 1918. The corundum used by domestic industry for many years was imported from Southern Rhodesia, but sanctions imposed in 1968 by the United Nations halted this trade. In 1969, the Office of Emergency Preparedness dropped corundum from the list of strategic and critical materials for stockpiling. Domestic industry imported corundum from the Republic of South Africa in 1973 and 1974 for local consumption.

Prices quoted in Engineering and Mining Journal, December 1974, for corundum, per short ton of crude, c.i.f. U.S. ports were as follows, in dollars:

Crystal	120–130
Boulder	70–75

Emery.—Two producers of emery were active in 1974; De Luca Emery Mine, Inc., and Bates Mine, both near Peekskill in Westchester County, N.Y. Data on value of production were withheld to avoid disclosing individual company confidential data. The quantity of emery produced decreased to 2,520 tons from the 2,884 tons produced in 1973. Domestic emery was used mostly in aggregate for heavy-duty nonslip floors, pavements, and stair treads. Smaller amounts of domestic emery were used in coated abrasives and tumbling abrasives.

World production data for emery are principally for Greece and Turkey. In 1973, production of emery in Greece was estimated to be 7,716 short tons. Production of emery in Turkey in 1973 was reported as 101,724 short tons valued at $923,000.

Prices quoted in Industrial Minerals, No. 87, December 1974, for emery, per metric ton, c.i.f. main European port were as follows, in dollars:

Coarse grain	90–105
Medium and fine grain	90–113

Table 8.—Natural corundum: World production by country

(Short tons)

Country [1]	1972	1973	1974 [p]
India	[r] 431	273	[e] 275
Malagasy Republic	3	--	--
South Africa, Republic of	324	297	303
U.S.S.R.[e]	7,700	7,700	7,700
Uruguay	--	335	[e] 380
Total	8,458	8,605	8,658

[e] Estimate. [p] Preliminary. [r] Revised.

[1] In addition to the countries listed, Southern Rhodesia presumably continued to produce natural corundum at a significant level (several thousand tons annually), and both Argentina and Kenya may have produced minor quantities of this commodity, but output is not reported, and available information is inadequate for formulation of reliable estimates of output levels.

INDUSTRIAL DIAMOND

Domestic production of synthetic industrial diamond in 1974 was estimated to be 19 million carats, an increase of 2 million carats over that of 1973. Secondary production, comprising salvage from used diamond tools and from wet and dry diamond-containing wastes, was estimated to be 2 million carats.

The Government stockpile inventory as of December 31, 1974, was 35.9 million carats of crushing bort and 21.1 million carats of stones. The objectives for both categories are zero, and the inventories were considered excess. Still available for disposal from prior enabling legislation were 12.2 million carats of bort and 1.1 million carats of stones. The inventory of small diamond dies was 25,473, of which the objective was 7,900, and 17,573 was excess.

Exports and reexports of industrial diamond dust and powder, which included synthetics, were 14.4 million carats valued at $35.8 million. Crushing bort, except dust and powder, exported amounted to 500,000 carats valued at $3.3 million. Exports and reexports of stones were 3.8 million carats valued at $30.7 million. The total of exports and reexports of dust and powder, bort, and stones was 18.7 million carats valued at $69.9 million.

Table 9.—U.S. imports for consumption of industrial diamond (excluding diamond dies)

(Thousand carats and thousand dollars)

Year	Quantity	Value
1972	15,134	52,619
1973 [r]	19,166	65,713
1974	18,418	62,920

[r] Revised.

Table 10.—U.S. imports for consumption of industrial diamond, by country

(Thousand carats and thousand dollars)

Country	Crushing bort (including all types of bort suitable for crushing)				Other industrial diamond (including glazers' and engravers' diamond, unset)				Miners' diamond				Powder and dust			
	1973		1974		1973		1974		1973		1974		1973		1974	
	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value
Australia	--	--	--	--	1	17	(1)	8	--	--	--	--	--	--	--	--
Belgium-Luxembourg	19	38	35	75	1,689	7,714	1,009	5,283	r 6	13	5	27	315	551	326	595
Belize	--	--	--	--	--	--	--	--	4	r 15	--	--	--	--	--	--
Brazil	(1)	(1)	--	--	4	59	--	--	--	--	1	20	--	--	--	--
British West Africa	--	--	--	--	7	40	2	6	11	46	--	--	--	--	--	--
Canada	3	9	1	7	59	369	38	252	2	18	(1)	2	312	258	464	297
Central African Republic	--	--	--	--	2	4	37	464	--	--	1	4	--	--	--	--
Congo (Brazzaville)	--	--	--	--	r 116	r 313	278	685	--	--	--	--	13	30	--	--
Cyprus	--	--	--	--	--	--	--	--	6	16	--	--	--	--	--	--
France	--	--	--	--	21	700	12	278	--	--	--	--	1	1	--	--
Germany, West	(1)	1	--	--	3	r 49	2	42	1	r 4	--	--	(1)	(1)	8	20
Ghana	--	--	--	--	54	849	59	453	9	45	4	25	4	8	1	4
Ireland	20	34	--	--	25	137	72	237	20	34	--	--	r 9,369	r 20,926	8,180	18,459
Israel	--	--	--	--	29	514	9	264	(1)	(1)	--	--	4	19	2	3
Japan	--	--	2	16	81	1,429	89	1,658	60	115	63	117	708	1,398	1,039	1,986
Liberia	--	--	--	--	10	58	(1)	16	--	--	--	--	--	--	--	--
Mauritania	--	--	--	--	9	14	1	2	--	--	--	--	58	96	3	5
Netherlands	1	2	16	35	311	2,994	472	3,312	--	--	12	55	89	232	36	77
Sierra Leone	--	--	--	--	1	100	--	--	--	--	--	--	1	1	--	--
South Africa, Republic of	11	27	70	160	1,651	r 10,214	1,475	9,383	838	4,201	1,194	6,000	125	190	16	38
Switzerland	2	8	--	--	3	36	40	182	3	13	2	24	110	175	150	162
U.S.S.R	--	--	--	--	20	31	--	--	--	--	--	--	724	1,060	556	746
United Kingdom	--	--	20	72	1,409	8,969	1,356	7,637	2	9	12	57	564	1,054	976	1,784
Venezuela	--	--	--	--	2	13	14	101	6	108	23	524	--	--	--	--
Western Portuguese Africa, n.e.c	--	--	--	--	29	288	78	848	--	--	--	--	1	1	1	3
Zaire	18	47	--	--	13	33	30	73	5	13	8	28	123	341	81	225
Other	--	--	--	--	13	41	12	31	--	--	--	--	41	76	30	58
Total	74	166	144	365	r 5,562	r 34,485	5,080	31,210	978	4,650	1,225	6,888	r 12,557	r 26,412	11,869	24,462

r Revised.

[1] Less than ½ unit.

WORLD REVIEW

Botswana.—In October, the Government announced its intent to take a 50% share in the equity of the Orapa diamond mine of De Beers Consolidated Mines, Ltd.[2] The arrangements were likely to result in an increase in the Government's share of the profits from Orapa from about 50% to more than 75%. De Beers introduced a third working shift in June, which raised the output from 2.4 million carats per year to 3 million carats.[3] The average recovery ratio of industrial to gem-quality stones recovered at Orapa is roughly 85:15.[4] The smaller Dk 1 pipe discovered by De Beers about 30 miles southeast of Orapa has been under an economic feasibility study for about 2 years. De Beers is negotiating with the Government on terms to bring the new mine into production.

Central African Republic.—Diamond production in 1974 was nearly 25% higher than that of 1973. Total exports of 343,950 carats valued at $14,372,000 accounted for about 35% of the nation's foreign exchange receipts. Société Centrafricaine d'Exploitation Diamantifére (SCED), a new company formed in 1973 by Cominco, Ltd., of Canada and Diamond Distributors Inc. of New York, had a successful first year and was planning to expand its river dredging operations.

Ghana.—Yearly production between 1968 and 1973 in Ghana's two diamondiferous areas—the Birim Basin (Eastern Region) and the Bonsa Region (Western Region) —has averaged 2.47 million carats, according to the Ghana Department of Mines.[5] Three companies, Ghana Consolidated Diamond, Ltd. (G.C.D.L.), Cayco (Ghana) Ltd., and the Amalgamated Diamond Corp., are actively engaged in mining diamonds in the Birim River Basin. First International Natura Corp. (FINCO) of the United States completed exploration in the Birim and Pra River Basins within an area of 24.7 miles from the confluence of the Birim and Pra Rivers. The Ghana Government will own 55% of the FINCO prospect. G.C.D.L., which is 55% owned by the Government of Ghana, and 45% by Consolidated African Selection Trust, produced about 96% of the diamond output in Ghana in the period 1968–73.

Greenland.—About a dozen small industrial diamonds were found at Fiskenaesset near the southern tip of Greenland according to the Aarhus Stifstidende, a Copenhagen newspaper.[6] De Beers Consolidated Mines Ltd., of the Republic of South Africa, planned further investigation to determine the source of the diamond.

Indonesia.—The state mining company, P. N. Aneka Tambang, closed its plant that processed alluvium for diamond at Talang Intan, Cempaka Putih, South Kalimantan following unfavorable results after a 5-year trial program. Mining for diamond in Indonesia is at a low level.

Ivory Coast.—Société Anonyme de Recherches et d'Exploitation Minières en Côte d'Ivoire and Waston Company experienced decreased diamond production due to a breaking-in period for new processing equipment at their respective plants.[7]

Lesotho.—On March 1, 1974, Finance Minister, E. R. Sekhonyana, announced that an agreement in principle had been reached between De Beers Diamond Corp. and the Government of Lesotho on opening the Letseng-la-terae diamond mine.[8] De Beers will improve the access road and carry out the mining operation. The project was estimated at over $30 million of which $4.5 million was for infrastructure and $25.5 million for capital work. About 2 years would be needed to reach production. The Government will have 25% equity and be represented on the Board of Directors. De Beers will handle the marketing of diamond through the Central Selling Organization by means of a diamond sales company registered in Lesotho.

Southern Rhodesia.—Kimberlitic Searches Ltd., a prospecting subsidiary of De Beers Consolidated Mines Ltd., was granted an exclusive prospecting order for about 60 square miles in the Bulawayo mining district effective until August 23, 1976.[9] This is the fourth exclusive prospecting order for De Beers, and to date, no indication of any commercial finds has been given. The granting of the order signifies that the application company wishes to conduct a more detailed examination.

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[2] Bureau of Mines. Diamond: Botswana. Mineral Trade Notes, v. 71, No. 11, November 1974, p. 7.

[3] Mining Magazine. Growth Ahead for Botswana Mining. V. 6, June 1974, pp. 451, 453.

[4] Mining Journal. Mining Week: Progress in Botswana? V. 284, No. 7281. Mar. 7, 1975, p. 167.

[5] Bureau of Mines. Diamond: Ghana. Mineral Trade Notes, v. 71, No. 7, July 1974, pp. 3–4.

[6] Washington Post. Diamond Probe in Greenland. No. 159, May 13, 1974, p. C–5.

[7] The Activities of the Mining Sector in 1974, Ivory Coast. Translations on Africa. Joint Pub. Res. Service, No. L 5230 GUO No. 453, Mar. 20, 1975, pp. 22–24.

[8] Bureau of Mines. Diamond: Lesotho. Mineral Trade Notes, v. 71, No. 5, May 1974, p. 3.

South Africa, Republic of.—Diamond sales by the Central Selling Organization in 1974 were R849 million ($1,189 million U.S.), or 7.8% lower than in 1973.[10] Sales in the first half of 1974 set a new record, and the reduction in the total was caused by a marked deterioration in sales in the second half. During this period excess production was absorbed into stock. No breakdown was given for sales of either gem stones or industrial diamond. Notwithstanding the slowdown in the world economy, sales of industrial diamond were higher in 1974 in both volume and value. The widespread increase in exploration for new sources of energy and gold resulted in increased usage of stones in drill bits. Toward the end of 1974, the sorting and classifying of diamonds produced by De Beers in South and Southwest Africa was centralized in a new building at Kimberly, which is also the new headquarters of the Diamond Producers Association.

Zaire.—The Government announced a decision on November 30, 1973, to take possession of the Société Minière de Bakwanga (MIBA) by increasing its shareholdings from 50% to 100%.[11] MIBA has had an output of about 12 million carats of diamond in recent years. About 83% is bort, 15% is industrial stones, and 2% is gem quality.

TECHNOLOGY

Four articles speculated that the kimberlite formations in West Africa, prior to the separation of Africa and South America by the continental drift, were the possible origin of diamonds in the Guiana Shield.[12] The Mines Division of De Beers Diamond Research Centre in Johannesburg, Republic of South Africa, continued development work on a number of projects.[13] These included a jet attritioner mill and plant for re-treating fine tailings, the use of centrifuges for treating slimes, magnetic separation of fine gravity concentrates, and the use of a heavy-media cyclone.

The invention of an inexpensive, flexible diamond abrasive tool with low carat content received the Richardson Gold Medal Award for Outstanding Merit from the Institute of Patentees and Inventors, London.[14] Tools of the new design have been used successfully for grinding and polishing stone, leveling ceramic tiles and glass, and surfacing plastics and a variety of woods. The basis of the invention is a flexible, meshlike structure on which the industrial diamond is deposited only on the land, exposed by the intersection of the weft and warp. About 16% of the total surface area of the tool contains diamond.

An article reported the results of research on three strength testing methods for diamond.[15] Diamond specimens researched were invariably small, irregular, and unique in their impurities and defects. The first study, the Hertzian method of strength measurements in which an indenter is pushed against the solid under test and the load measured, revealed that diamond must be used as the indenter also to obtain reliable results. The second study, a compression test of single particles to fracture, showed that the results depended

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[9] Engineering and Mining Journal. Exploration Round Up. Rhodesia: The Search for Diamonds. V. 175, No. 10, October 1974, p. 17.

[10] De Beers Consolidated Mines Limited. 1974 Annual Report. 52 pp.

[11] Mining Journal. Société Minière de Bakwanga (MIBA). V. 282, No. 7241, May 31, 1974, p. 444.

[12] Reid, A. R. Proposed Origin for Guianian Diamonds. Geology, v. 2, No. 2, February 1974, pp. 67–68.

Schonberger, H., and E. W. F. de Roever. Possible Origin of Diamonds in the Guiana Shield: Comment. Geology, v. 2, No. 10. October 1974, pp. 474–475.

Hastings, D. A. Proposed Origin for Guianian Diamonds: Comment. Geology, v. 2, No. 10, October 1974, pp. 475–476.

Reid, A. A. Proposed Origin for Guianian Diamonds: Reply. Geology, v. 2, No. 10, October 1974, p. 476.

[13] De Beers Consolidated Mines Limited. 1974 Annual Report. P. 25.

[14] Industrial Diamond Review. New Flexible Tool Concept Promises Increased Scope for Diamond Utilization. October 1974, pp. 358–362.

[15] Field, J. E., H. M. Hauser, I. M. Hutchings, and A. C. Woodward. Strength Testing Diamond. Ind. Diamond Rev., July 1974, pp. 224–259.

Table 11.—Diamond (natural): World production by country[1]
(Thousand carats)

Country	1972			1973			1974 [p]		
	Gem	Industrial	Total	Gem	Industrial	Total	Gem	Industrial	Total
Africa:									
Angola	1,616	539	2,155	1,594	531	2,125	1,600	500	[e] 2,100
Botswana	360	2,048	2,408	362	2,054	2,416	408	2,310	2,718
Central African Republic	346	178	524	251	129	380	300	150	[e] 450
Ghana	266	2,393	2,659	232	2,085	2,317	257	2,316	[e] 2,573
Guinea [e]	25	55	80	25	55	80	25	55	80
Ivory Coast	184	200	384	120	180	300	130	190	[e] 320
Lesotho [2]	1	8	9	1	[r] 8	9	2	9	11
Liberia [3]	[4] 481	[4] 409	[4] 890	[r] 509	[r] 308	[r] 817	377	259	636
Sierra Leone [3]	720	1,080	1,800	646	758	1,404	670	1,000	[e] 1,670
South Africa, Republic of:									
Premier mine	613	1,841	2,454	625	1,876	2,501	605	1,817	2,422
Other de Beers Company [5]	2,291	[r] 1,874	[r] 4,165	2,368	1,938	4,306	2,397	1,961	4,358
Other	466	[r] 310	[r] 776	455	303	758	433	289	722
Total	3,370	4,025	7,395	3,448	4,117	7,565	3,435	4,067	7,502
South West Africa, Territory of	1,516	80	1,596	1,520	80	1,600	1,491	79	1,570
Tanzania	326	[r] 326	[r] 652	[r] 251	[r] 250	[r] 501	275	275	[e] 550
Zaire	[r] 1,332	[r] 12,058	13,390	[r] 1,082	[r] 11,858	12,940	1,100	11,900	[e] 13,000
Other Areas:									
Brazil [e]	155	155	310	160	160	320	160	160	320
Guyana	20	29	49	[r] 31	[r] 21	52	30	20	50
India	17	3	20	18	3	21	17	3	[e] 20
Indonesia [e]	12	3	15	12	3	15	12	3	15
U.S.S.R [e]	1,850	7,350	9,200	1,900	7,600	9,500	1,950	7,850	9,800
Venezuela	141	315	456	[r] 315	[r] 463	[r] 778	280	420	700
World total	12,688	31,249	43,937	12,477	30,663	43,140	12,519	31,566	44,085

[e] Estimate. [p] Preliminary. [r] Revised.

[1] Total (gem plus industrial) diamond output for each country is actually reported except where indicated to be an estimate by footnote. In contrast, the detailed separate reporting of gem diamond and industrial diamond represents Bureau of Mines estimates in the case of every country except the Central African Republic (1972 and 1973), Lesotho (1972 and 1973), Liberia (all years), Guyana (1972 and 1973), and Venezuela (1972 and 1973), where sources give both total output and detail. The estimated distribution of total output between gem and industrial diamond is conjectural in the case of a number of countries, based on unofficial information of varying reliability.

[2] Exports of diamond originating in Lesotho; excludes stones imported for cutting and subsequently reexported.

[3] Exports.

[4] Revised from data in previous edition, which were for years ending August 31 of that stated, to normal calendar year basis.

[5] All company output from the Republic of South Africa except for that from the Premier mine; also excludes company output from the Territory of South West Africa and Botswana.

on the shape, size, defect content of the specimen, and the anvil material. The third study, a comparison of the strength of natural diamond versus synthetic diamond showed that natural diamond is stronger in applications involving high temperatures or in heat cycling.

Abstracts relative to properties of diamond hard materials, machines, and patents were published monthly in the Industrial Diamond Review. Each issue, January to December 1974, contained from 14 to 18 pages of abstracts and patent information.

ARTIFICIAL ABRASIVES

Five firms in the United States and in Canada produced crude fused aluminum oxide in 1974. Operators of plants in both countries were: The Carborundum Co., Norton Co., and General Abrasive Co. The Exolon Co., and Simonds Canada Abrasive Co., Ltd., operated plants in Canada. The production of white, high-purity material was 33,298 tons, and production of regular grade was 207,921 tons. Of the combined output of white and regular, 11% was used for nonabrasive applications, principally in the manufacture of refractories. The production was 95% of the rated capacity of the furnaces assigned to fused aluminum oxide.

Four firms, The Carborundum Co., Exolon Co., General Abrasive Co., and Norton Co., produced crude fused alumina zirconia abrasive in the United States and in Canada in 1974. All production was reportedly used for abrasive applications. The output was 55% of the capacity of the furnaces assigned to the production of fused alumina zirconia.

Six firms in the United States and Canada produced silicon carbide in 1974. The Carborundum Co. operated plants in both countries and Electro-Refractories & Abrasives Canada, Ltd., Exolon Co., Norton Co. and General Abrasive Co., operated in Canada. These five companies produced crude for abrasive, refractory, and other nonabrasive uses. Satellite Alloy Corp. operated in the United States and produced crude for nonabrasive applications. Production by the six firms was 86% of capacity and 38% was reportedly used for abrasive applications. Nonabrasive use was 62% of the output and was mostly for refractory and metallurgical applications.

In the Stockpile Report to the Congress by the General Services Administration the inventory of crude fused aluminum oxide in calendar 1974 was reduced by 45,369 tons to 267,062 tons as of December 31; the stock of aluminum oxide abrasive grain was unchanged at 50,905 tons; and the stock of silicon carbide crude was reduced by 77,588 tons to 118,865.

Metallic abrasives were produced in 1974 by 13 firms in the United States. Steel shot and grit comprised 72% of the total quantity sold or used; chilled iron shot and grit, 17%; annealed iron shot and grit, 10%; other metallic abrasives comprised the remainder. The amounts from Ohio were 31% of the total sold or used, the highest of the producing States. Michigan, Indiana, and Pennsylvania followed in quantity sold or used; their combined total represented 60% of the national total. The remainder was from plants in Alabama, New York, and Connecticut. Three companies reworked material: Copperweld Steel Co. of Glassport, Pa.; Industeel Corp. of Pittsburgh, Pa.; and Kohler Co. of Sheboygan, Wis.

Producers of metallic abrasives were as follows:

Company	*Plants*
Abbott Ball Co	Hartford, Conn.
Abrasive Materials, Inc	Hillsdale, Mich.
Abrasive Metals Co	Pittsburgh, Pa.
The Carborundum Co	Butler, Pa.
Cleveland Metal Abrasive Co.	Birmingham, Ala. Howell, Mich. Springville, N.Y. Cleveland, Ohio Toledo, Ohio
Durasteel Co	Pittsburgh, Pa.
Ervin Industries, Inc	Adrian, Mich.
Globe Steel Abrasive Co	Mansfield, Ohio
Metal Blast, Inc	Cleveland, Ohio
National Metal Abrasive Co	Do.
Pellets, Inc	Tonawanda, N.Y.
Steel Abrasives, Inc	Hamilton, Ohio
Wheelabrator-Frye, Inc	Mishawaka, Ind.

TECHNOLOGY

One of the objectives of the Grinding Wheel Institute (GWI) is the development of greater understanding of how the grinding process works. A GWI project was carried out at Carnegie-Mellon University to study the vertical spindle surface grinding process. The first part of a 4-part series to explain the principle was published.[16] Major advances in grinding techniques have resulted from the development of digital programing, automatic loading, and automatic monitoring of machine operations.[17] New grinding wheels and equipment will permit high-speed grinding up to 16,000 feet per minute versus the present high of 12,000 feet per minute.

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[16] Retford, T. What's Going on at the Surface. Abrasive Eng., v. 20, No. 5, September–October 1974, pp. 14–15.

[17] Mari, A. New Era of Growth Seen in High Speed Grinding, Machining. Am. Metal Market and Metalworking News, v. 81, No. 141, pp. 11–12.

The addition of less than 1% boron to silicon carbide permits fabrication of ceramic parts such as jet blades for turbines, and combustors and duct works by conventional forming and sintering methods.[18]

Norway is the largest silicon carbide producing country in Europe, with an annual output of about 60,000 tons per year from three producers.[19] The technology and current operating practices of the producers, A/S Arendal Smelteverk (a Carborundum Co. subsidiary) at Arendal, K/S Orkla Exolon A/S & Co. (an affiliate of Exolon Co.) with Orkla Industries A. S. and with Christiana Spigerverk A/S at Orkanger on Trondheimsfjord, and Norton A/S (a Norton Co. subsidiary) near Lillesand in southern Norway, were described.

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[18] American Metal Market and Metalworking News. Adding 1% Boron to Silicon Carbide Allows Conventional Forming. G. E. Says. V. 81, No. 29, Feb. 11, 1974, p. 14.

[19] Industrial Minerals (London). Scandinavia-Norway's Industrial Minerals. No. 88, January 1975, pp. 19–52.

Table 12.—Crude artificial abrasives produced in the United States and Canada

(Thousand short tons and thousand dollars)

Kind	1970	1971	1972	1973	1974
Silicon carbide[1]	167	130	166	162	163
Value	24,038	21,123	24,690	25,471	33,872
Aluminum oxide (abrasive grade)[1]	195	149	184	196	241
Value	27,402	24,514	28,590	27,339	40,906
Aluminum zirconium oxide	--	--	--	22	25
Value	--	--	--	6,223	9,839
Metallic abrasives[2]	199	193	235	266	301
Value	34,332	33,390	39,678	49,775	91,061
Total	561	472	585	646	730
Value	85,772	79,027	92,958	108,808	175,678

[1] Figures include material used for refractories and other nonabrasive purposes.

[2] Shipments for U.S. plants only.

Table 13.—Production, shipments, and annual capacities of metallic abrasives in the United States, by product

Year and product	Manufactured		Sold or used		Annual capacity[1]
	Quantity (short tons)	Value (thousands)	Quantity (short tons)	Value (thousands)	(short tons)
1973:					
Chilled iron shot and grit	35,024	$3,992	45,196	$6,295	61,400
Annealed iron shot and grit	7,739	712	9,984	1,405	29,480
Steel shot and grit	194,580	33,679	206,918	41,104	243,370
Other[2]	3,575	903	3,792	972	[r] 10,760
Total	240,918	39,286	265,890	49,776	[r] 345,010
1974:					
Chilled iron shot and grit	47,872	8,460	50,966	11,891	162,000
Annealed iron shot and grit	30,781	5,842	29,546	6,614	([2])
Steel shot and grit	215,800	57,233	217,427	71,389	240,650
Other[2]	3,166	829	3,247	1,167	10,760
Total	297,619	72,364	301,186	91,061	413,410

[r] Revised.

[1] The total quantity of the various types of metallic abrasives that a plant could have produced during the year, working three 8-hour shifts per day, 7 days per week, allowing for usual interruptions, and assuming adequate fuel, labor, and transportation.

[2] Included in capacity of chilled iron shot and grit. Includes cut-wire shot.

Table 14.—Stocks of crude artificial abrasives and capacity of manufacturing plants in the United States and Canada

(Thousand short tons)

Year	Silicon carbide		Aluminum oxide		Aluminum zirconium oxide	
	Stocks Dec. 31	Annual capacity	Stocks Dec. 31	Annual capacity	Stocks Dec. 31	Annual capacity
1970	18.7	179.1	30.8	359.2	--	--
1971	14.2	198.1	25.6	293.2	--	--
1972	5.2	195.7	16.3	291.2	--	--
1973	5.4	189.1	19.3	284.6	0.7	26.9
1974	4.7	190.5	20.5	319.1	0.7	45.6

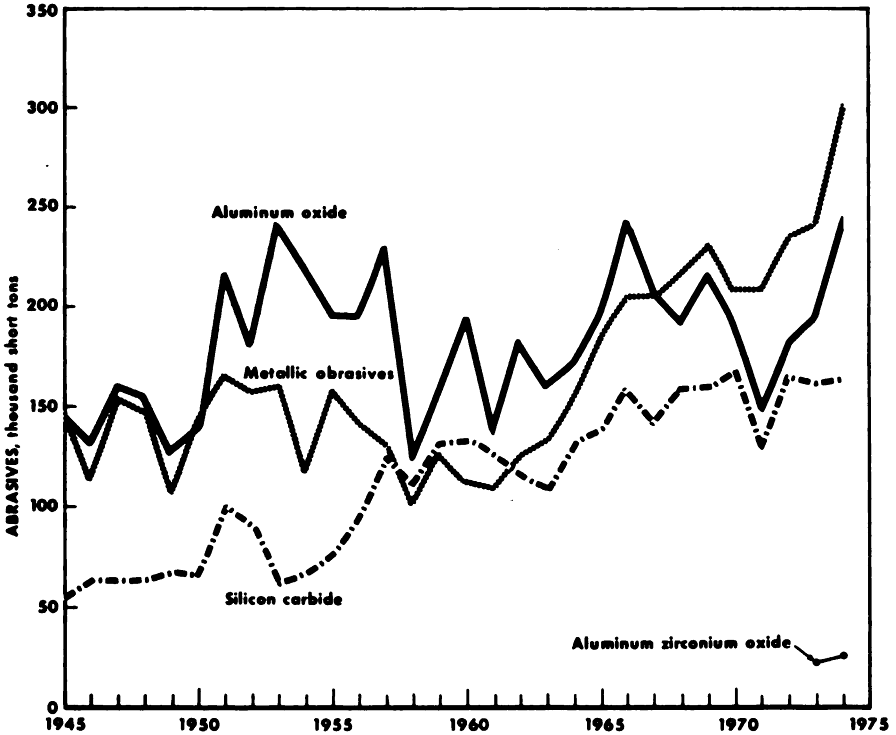

Figure 1.—Artificial abrasives production.

Aluminum

By John W. Stamper [1] and Christine M. Monroe [2]

Domestic production of primary aluminum of 4.9 million tons set a new record and was virtually 100% of yearend capacity. However, as economic activity began to decrease during the last half of the year aluminum demand also decreased; net shipments to domestic end users for the year were down almost 8%. By yearend, producers began to cut back production levels as inventories began to increase beyond normal levels.

The dramatic increase in energy costs following the oil embargo by the Organization of Petroleum Exporting Countries (OPEC) in late 1973 caused a significant increase in the cost of producing aluminum in 1974. The aluminum industry expanded its efforts to save energy throughout the aluminum production cycle.

The Aluminum Association, through a survey of its members, determined the quantity and form of energy used in 1972 and 1973 in the production of aluminum metal from the mining of bauxite through the production of aluminum mill products. The study showed that about 53% of the total energy used by the aluminum industry in 1973 was in the form of petroleum products and natural gas, 36% was coal, 10% was hydroelectric power, and 1% was nuclear energy. About 56% of the energy used was for generating either purchased or self-generated electricity at an energy efficiency of 31.5%.

Table 1.—Salient aluminum statistics
(Thousand short tons and thousand dollars)

	1970	1971	1972	1973	1974
United States:					
Primary production	3,976	3,925	4,122	4,529	4,903
Value	$2,190,087	$2,154,446	$2,084,946	$2,206,440	$3,005,640
Price: Ingot, average cents per pound	28.7	29.0	r 26.3	r 25.3	34.1
Secondary recovery	781	816	946	r 1,040	993
Exports (crude and semicrude)	612	293	329	561	524
Imports for consumption (crude and semicrude)	468	690	794	614	629
Consumption, apparent	4,519	5,099	5,588	5,685	5,863
World: Production	10,641	11,378	r 12,133	r 13,393	14,517

r Revised.

Legislation and Government Programs.—The shipment of 510,741 tons of primary aluminum from government inventories during 1974 under the aluminum disposal program that became effective November 23, 1965, brought the total shipped under the program to almost 1.9 million tons. From December 1, 1965, to December 31, 1974, shipments of primary aluminum by the General Services Administration were as follows, in short tons:

1965	9,374	1970	24,261
1966	325,925	1971	21
1967	61,599	1972	6,125
1968	56,554	1973	730,249
1969	139,635	1974	510,741
		Total	1,864,484

All of the approximately 13,000 tons of aluminum metal (all grades) remaining in government inventories at the end of 1974 was sold or committed for sale but not delivered.

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DOMESTIC PRODUCTION

Primary.—Primary aluminum production capacity was unchanged in 1974; however, output increased 8% to a new record. Demand decreased toward the end of the year, and production at the Reynolds Metals Co. reduction plants at Jones Mills, Ark., and Listerhill, Ala., and at the Ormet Corp., Hannibal, Ohio, plant was reduced in December. Further reductions in the operating rates of these and other companies were scheduled for early 1975.

Aluminum Co. of America (Alcoa) planned to add about 60,000 tons per year to the capacity of its Badin, N.C., alumina reduction plant, raising annual capacity to about 180,000 tons in 1976. The company also was phasing out three 20,000-ton-per-year lines at its Massena, N.Y., reduction plant and replacing them with a 120,000-ton-per-year super line for a net increase of 60,000 tons, raising capacity there to about 190,000 tons per year. A $10.4 million loan was arranged with Bankers Trust Co. to finance installation of pollution control equipment for the new line and for carbon baking facilities. Alcoa also was planning to begin construction in 1977 to more than double its power-generating facilities at Rockdale, Tex., to 935 megawatts. The new generating plant was scheduled to use lignite.

Table 2.—Production and shipments of primary aluminum in the United States
(Short tons)

Quarter	1973		1974	
	Production	Shipments	Production	Shipments
First	1,111,655	1,155,124	1,199,623	1,201,575
Second	1,123,450	1,139,421	1,236,227	1,234,597
Third	1,127,223	1,130,202	1,228,569	1,224,291
Fourth	1,166,788	1,162,601	1,239,007	1,159,991
Total	4,529,116	4,587,348	4,903,426	4,820,454

Anaconda Aluminum Co. and Alcoa agreed to exchange information on the technology for producing alumina from materials other than bauxite, the present source of aluminum.

On January 30, 1974, Amax Inc. sold a 50% interest in substantially all of its aluminum business to Mitsui & Co., Ltd., a primary aluminum producer in Japan, for about $135 million in cash. The joint aluminum business will be operated by a separate corporation named Alumax Inc. Alumax owned 50% of the Intalco Aluminum Corp. 260,000-ton-per-year alumina reduction plant at Ferndale, Wash., and was constructing a 90,000-ton-per-year addition to the Eastalco Aluminum Co. aluminum plant at Frederick, Md., owned by Péchiney Ugine Kuhlmann (PUK) of France and Howmet Corp., which owned half of the Intalco plant. The new line, which was expected to be completed in 1975, cost $110 million and would be operated as a unit with the existing line. In addition, Alumax and Mitsui & Co., Ltd., were planning to build a 187,300-ton-per-year primary aluminum plant in Oregon if necessary government approval could be obtained. This plant was to be financed equally by Alumax and Mitsui & Co., Ltd., at a total estimated cost of $340 million.

Table 3.—Primary aluminum production capacity in the United States, by company
(Thousand short tons)

Company and plant	Capacity at yearend 1974	Ownership
Aluminum Co. of America (Alcoa):		Self, 100%.
Alcoa, Tenn	1,575	
Badin, N.C		
Evansville (Warrick), Ind		
Massena, N.Y		
Point Comfort, Tex		
Rockdale, Tex		
Vancouver, Wash		
Wenatchee, Wash		
Total	1,575	
Anaconda Aluminum Co.:		Self, 100%.
Columbia Falls, Mont	180	
Sebree, Ky	120	
Total	300	
Consolidated Aluminum, Inc.:		Swiss Aluminium Ltd. 60%; Phelps Dodge Corp. 40%.
Lake Charles, La	36	
New Johnsonville, Tenn	141	
Total	177	
Eastalco Aluminum Co.: Frederick, Md	88	Péchiney Ugine Kuhlmann Group 70%; Howmet Corp. 30%.
Intalco Aluminum Corp.: Ferndale (Bellingham) Wash	260	Amax Inc. 25%; Péchiney Ugine Kuhlmann Group 35%; Mitsui & Co. Ltd. 25%; Howmet Corp. 15%.
Kaiser Aluminum & Chemical Corp.:		Self, 100%.
Chalmette, La	260	
Mead, Wash	220	
Ravenswood, W. Va	163	
Tacoma, Wash	81	
Total	724	
Martin Marietta Aluminum, Inc.:		Martin Marietta Corp. 87.2%; private interest 12.8%.
Goldendale, Wash	115	
The Dalles, Oreg	90	
Total	205	
National-Southwire Aluminum Co.: Hawesville, Ky	180	National-Steel Corp. 50%; Southwire Co. 50%.
Noranda Aluminum Inc.: New Madrid, Mo	70	Noranda Mines, Ltd. 100%.
Ormet Corp.: Hannibal, Ohio	250	Swiss Aluminium Ltd. 40%; Revere Copper & Brass, Inc. 34%; Phelps Dodge Corp. 26%.
Revere Copper & Brass, Inc.: Scottsboro, Ala	112	Self, 100%.
Reynolds Metals Co.:		Self, 100%.
Arkadelphia, Ark	68	
Corpus Christi (San Patricio), Tex	114	
Jones Mills, Ark	125	
Listerhill (Sheffield), Ala	202	
Longview, Wash	210	
Massena, N.Y	126	
Troutdale, Oreg	130	
Total	975	
Total United States	4,916	

Noranda Aluminum Inc. planned to double its capacity to produce primary aluminum at New Madrid, Mo., to 140,000 tons per year by 1976 at an estimated cost of $80 million. An additional $12 million was expected to be spent on improved pollution controls at the plant, which was built for Noranda in 1971 by Kaiser Aluminum & Chemical Corp. Kaiser also provides alumina to the plant under a long-term contract.

Noranda Mines Ltd. of Toronto, Canada, purchased the 38.5% interest owned by Olin Corp. in Frialco, a bauxite-alumina consortium in the Republic of Guinea. Noranda Aluminum, Inc., is a wholly-owned subsidiary of Noranda Mines.

Preliminary plans to triple the annual

capacity of the Revere Copper & Brass, Inc., primary aluminum plant at Scottsboro, Ala., with financial and technical assistance of six Japanese aluminum firms, were announced.

Consolidated Aluminum Inc. (Conalco) acquired 32% of the half interest formerly owned by Revere Copper & Brass, Inc. in the Ormet primary aluminum plant at Hannibal, Ohio. The purchase brought the interest in Ormet owned by Conalco to 66%.

Secondary.—Recovery of secondary aluminum from purchased aluminum-base scrap, calculated from reports to the Bureau of Mines, was 993,431 tons, 4% less than the quantity recovered in 1973. Calculated recovery of all metallic constituents from aluminum-base scrap in 1974 declined 4% to 1,058,091 tons.

The Bureau estimated that full coverage of the industry would indicate a total scrap consumption of 1,448,000 tons in 1974. On this basis, aluminum recovery would total 1,190,000 tons, and total metallic recovery would be 1,282,000 tons.

Based on data supplied by its members. The Aluminum Association estimated that 2.3 billion all-aluminum cans were returned in 1974 up from 1.6 billion cans estimated in 1973. Assuming that 23 to 25 cans make a pound, this quantity would be equivalent to about 79,000 tons of aluminum cans that were recycled in 1974. Reynolds Metals Co., a primary producer, estimated that it accounted for about 70% of the total cans collected in 1973 and announced that it was expanding its capability to collect aluminum cans throughout the United States. The $3 million program will bring the company's total to 83 collection centers and over 100 mobile units and will expand its recycling activities to 45 States.

Table 4.—Aluminum recovered from scrap processed in the United States, by kind of scrap and form of recovery

(Short tons)

Kind of scrap	1973	1974	Form of recovery	1973	1974
New scrap:			As metal	121,020	99,587
Aluminum-base	[1] 841,966	[2] 779,978	Aluminum alloys	890,697	816,596
Copper-base	132	86	In brass and bronze	4,630	4,871
Zinc-base	108	112	In zinc-base alloys	11,166	10,374
Magnesium-base	382	270	In magnesium alloys	3,526	4,236
			In chemical compounds	8,769	57,767
Total	842,588	780,446	Total	1,039,808	993,431
Old scrap:					
Aluminum-base	[1] 196,514	[2] 211,987			
Copper-base	68	76			
Zinc-base	536	664			
Magnesium-base	102	258			
Total	197,220	212,985			
Grand total	1,039,808	993,431			

[1] Aluminum alloys recovered from aluminum-base scrap in 1973, including all constituents, were 886,461 tons from new scrap and 219,580 tons from old scrap and sweated pig, a total of 1,106,041 tons.

[2] Aluminum alloys recovered from aluminum-base scrap in 1974, including all constituents were 821,538 tons from new scrap and 236,553 tons from old scrap and sweated pig, a total of 1,058,091 tons.

Table 5.—Consumption of and recovery from purchased new and old aluminum scrap in 1974[1]

(Short tons)

Class	Consumption	Calculated recovery	
		Aluminum	Metallic
Secondary smelters	630,223	491,364	533,404
Primary producers	238,958	209,851	221,419
Fabricators	206,343	184,312	190,483
Foundries	72,770	63,035	66,693
Chemical producers	57,767	43,403	46,092
Total	1,206,061	991,965	1,058,091
Estimated full industry coverage	1,448,000	1,190,000	1,282,000

[1] Excludes recovery from other than aluminum-base scrap.

Table 6.—Stocks, receipts, and consumption of new and old aluminum scrap and sweated pig in the United States in 1974 [1]

(Short tons)

Class of consumer and type of scrap	Stocks Jan. 1 [r]	Receipts	Consumption	Stocks Dec. 31
Secondary smelters: [2]				
New scrap:				
Solids:				
Segregated low copper (Cu maximum, 0.4%)	3,513	89,490	88,856	4,147
Segregated high copper	531	11,766	11,962	335
Mixed low copper (Cu maximum, 0.4%)	2,305	89,213	85,748	5,770
High zinc (7000 series type)	179	6,592	6,420	351
Mixed clips	4,687	68,229	68,672	4,244
Borings and turnings:				
Low copper (Cu maximum, 0.4%)	811	32,556	28,811	4,556
Zinc, under 0.5%	562	11,452	11,013	1,001
Zinc, 0.5% to 1.0%	2,559	57,752	56,736	3,575
Foil, dross, skimmings	4,746	65,893	63,569	7,070
Other new scrap	1,284	20,713	20,453	1,494
Total new scrap	21,127	453,656	442,240	32,543
Old scrap (solids)	7,484	124,030	124,942	6,572
Sweated pig (purchased for own use)	3,718	65,348	63,041	6,025
Total all classes	32,329	643,034	630,223	45,140
Primary producers, foundries, fabricators, and chemical plants:				
New scrap:				
Solids:				
Segregated low copper (Cu maximum, 0.4%)	6,972	219,287	211,086	15,173
Segregated high copper	28	5,884	5,743	169
Mixed low copper (Cu maximum, 0.4%)	18,769	147,925	131,513	35,181
High zinc (7000 series type) and mixed clips	320	7,964	7,934	350
Borings and turnings:				
Low copper (Cu maximum, 0.4%)	W	W	W	W
Zinc, under 0.5%	W	W	W	W
Zinc, 0.5% to 1.0%	W	W	W	W
Foil, dross, skimmings	1,929	33,989	33,688	2,230
Other new scrap	925	90,188	89,986	1,127
Total new scrap [3]	24,032	506,274	481,046	49,260
Old scrap (solids)	4,895	69,664	70,837	3,722
Sweated pig (purchased for own use)	4,356	23,704	23,955	4,105
Total all classes	33,283	599,642	575,838	57,087
Total of all scrap consumed:				
New scrap:				
Solids.				
Segregated low copper (Cu maximum, 0.4%)	10,485	308,777	299,942	19,320
Segregated high copper	559	17,650	17,705	504
Mixed low copper (Cu maximum, 0.4%)	16,074	237,138	217,261	35,951
High zinc (7000 series type)	179	7,620	7,297	502
Mixed clips	5,007	75,165	75,729	4,443
Borings and turnings:				
Low copper (Cu maximum, 0.4%)	834	32,557	28,835	4,556
Zinc, under 0.5%	562	11,452	11,013	1,001
Zinc, 0.5% to 1.0%	2,625	58,788	57,808	3,605
Foil, dross, skimmings	6,675	99,882	97,257	9,300
Other new scrap	2,159	110,901	110,489	2,621
Total new scrap	45,159	959,930	923,286	81,803
Old scrap (solids)	12,379	193,694	195,779	10,294
Sweated pig (purchased for own use)	8,074	89,052	86,996	10,130
Total all classes	65,612	1,242,676	1,206,061	102,227

[r] Revised. W Withheld to avoid disclosing individual company confidential data.

[1] Includes imported scrap.

[2] Excludes secondary smelters owned by primary aluminum companies.

[3] Includes data withheld.

Table 7.—Production and shipments of secondary aluminum alloys by independent smelters

(Short tons)[1] [2]

	1973		1974	
	Production	Shipments	Production	Shipments
Pure aluminum (Al minimum, 97.0%)[3]	121,020	123,097	99,587	95,982
Aluminum-silicon:				
95/5 Al-Si, 356, etc. (maximum Cu 0.6%)	19,579	19,977	29,094	28,371
13% Si, 360, etc. (maximum Cu 0.6%)	56,899	58,182	50,642	48,198
Aluminum-silicon (Cu 0.6% to 2%)	3,981	4,029	4,771	4,609
No. 12 and variations	10,407	11,037	21,406	21,258
Aluminum-copper (maximum Si, 1.5%)	4,630	4,577	4,871	4,859
No. 319 and variations	62,347	62,739	52,728	52,039
Nos. 122 and 138	53	49	--	17
380 and variations	405,585	410,442	340,248	329,252
Aluminum-silicon-copper-nickel	4,672	4,985	6,250	6,181
Deoxidizing and other destructive uses:				
Grades 1 and 2	23,580	24,006	27,172	26,596
Grades 3 and 4	6,491	5,924	5,134	5,270
Aluminum-base hardeners	7,351	7,487	4,542	4,468
Aluminum-magnesium	3,526	3,476	4,236	4,180
Aluminum-zinc	11,166	11,530	10,374	9,876
Miscellaneous	20,809	20,661	18,407	18,540
Total	762,096	772,198	679,462	659,696

[1] Gross weight, including copper, silicon, and other alloying elements. Secondary smelters used 34,797 and 39,301 tons of primary aluminum in 1973 and 1974, respectively, in producing secondary aluminum-base alloys.

[2] No allowance was made for consumption or receipts by producing plants.

[3] Includes aluminum extrusion billet made from purchased aluminum-base scrap.

Several reports were published on can recycling activity by primary aluminum producers and others[3] and an assessment of the potential for recovering energy, aluminum, and other values from municipal wastes.[4]

Plans were announced for a $100 million industrial complex to be based on the Connecticut Resource Recovery Authority (CRRA) resources recovery plant to be located in Wallingford, Conn. City officials met with representatives of the glass recycling, detinning, steel, and aluminum industries to discuss locating ancillary reuse industries next to the separation center. It is estimated that the resource recovery center could turn out 26 tons of aluminum, 400 tons of glass, 380 tons of iron and steel, 11 tons of nonferrous metals other than aluminum, 300 tons of sand, and 300 tons of heavy organic matter each day. The organics would constitute feed for a proposed pyrolytic plant.

The Tennessee Valley Authority (TVA) was studying a plan for recycling solid wastes, including aluminum, from an area stretching across several States, and it has asked 31 equipment manufacturing companies to submit information on their ability to supply one or more 1,000-ton-per-day waste processing plants.

Success of the project depended on the results of tests to be conducted at the Shawnee Steam Plant near Paducah, Ky., to determine if the combustible portion of the refuse can be satisfactorily mixed with coal and burned in TVA's present plants and to determine if cost estimates are accurate.

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[3] Modern Metals. Recycling Garbage for Fun and Profit. V. 30, No. 11, December 1974, pp. 97–106.

[4] Abert, J. G., H. Alter, and J. F. Bernheisel. The Economics of Resource Recovery From Municipal Solid Waste. Sci. Mag., v. 183, No. 4129, Mar. 15, 1974, pp. 1052–1058.

CONSUMPTION

Domestic aluminum consumption as measured by net shipments to the domestic industry in 1974 was rising at a rapid rate at the beginning of the year, but the trend was reversed by yearend. Average end-use for 1974 was 7.8% below that of 1973. Applications in building and construction showed the greatest decrease, 15.2% below those in the previous year. Uses in transportation, consumer durables, and miscellaneous applications also decreased substantially, but shipments to the containers and packaging and machinery industries gained about 10% each. Electrical applications dropped moderately.

According to Aluminum Association data, aluminum shipments for the manufacture of windows, doors, and screens, which accounted for about 26% of the building and construction applications, totaled about 400,000 tons, 20% less than in 1973. Mobile homes accounted for about 139,000 tons, representing a 39% decline from 1973 shipments. Residential siding, the second largest use for building and construction, dropped only 7% to 266,000 tons; bridge, street, and highway construction actually increased slightly to about 89,000 tons.

In transportation, 1974 aluminum usage in passenger cars dropped 23% to 510,000 tons, while aluminum used in trucks and buses decreased only 10% to 187,000 tons. Trailers and semitrailers accounted for about 200,000 tons of aluminum in 1974, a 12% drop.

Air conditioners, freezers, and refrigeration applications accounted for about 151,000 tons of aluminum in 1974, a decline of 19%. Aluminum shipped for metal cans totaled 770,000 tons, up almost 18% from the 1973 level. In the machinery and equipment field, cryogenic, petroleum, and gas applications showed significant growth.

Table 8.—Distribution of end-use shipments of aluminum products

Industry	1973 [r]		1974	
	Quantity (thousand short tons)	Percent of total	Quantity (thousand short tons)	Percent of total
Building and construction	1,813	24.7	1,587	22.6
Transportation	1,406	19.1	1,215	17.8
Containers and packaging	1,028	14.0	1,133	16.6
Electrical	927	12.6	914	13.5
Consumer durables	670	9.1	578	8.5
Machinery and equipment	475	6.5	520	7.6
Other markets	435	6.0	372	5.5
Statistical adjustment	120	1.6	70	1.0
Total to domestic users	6,874	93.6	6,339	93.1
Exports	470	6.4	472	6.9
Total	7,344	100.0	6,811	100.0

[r] Revised.

Source: The Aluminum Association, Inc.

Table 9.—Apparent consumption of aluminum in the United States

(Short tons)

Year	Primary sold or used by producers [1]	Imports (net) [2]	Recovery from old scrap [3]	Recovery from new scrap [3]	Total apparent consumption [1]
1970	3,878,920	−141,796	145,576	635,848	4,518,548
1971	3,887,429	+396,408	167,030	648,138	5,099,005
1972	4,177,190	+466,765	188,594	755,762	5,588,311
1973	4,587,848	+59,484	196,514	841,966	5,685,812
1974	4,820,454	+50,706	211,987	779,978	5,863,125

[1] Excludes primary aluminum sold by General Services Administration 1970, 24,261 tons; 1971, 21 tons; 1972, 6,125 tons; 1973, 730,000 tons; and 1974, 509,000 tons.

[2] Crude and semicrude data for 1970–73 include ingot equivalent of scrap imports and exports (weight multiplied by 0.9). Data for 1974 exclude imports of scrap.

[3] Aluminum content.

Table 10.—Net shipments of aluminum wrought[1] and cast products by producers

(Short tons)

	1973	1974
Wrought products:		
Sheet, plate foil	3,257,856	3,187,222
Rolled and continuous cast rod and bar; wire	675,221	696,172
Extruded rod, bar, pipe, tube, shapes; drawn and welded tubing and rolled structural shapes	1,317,781	1,191,963
Powder flake paste	128,698	88,584
Forgings (including impacts)	71,186	69,156
Total	5,450,742	5,233,097
Castings:		
Sand	129,825	133,911
Permanent mold	220,100	188,544
Die	652,184	544,228
Others	10,918	13,052
Total	1,013,027	879,735
Grand total	6,463,769	6,112,832

[1] Net shipments derived by subtracting the sum of producers' domestic receipts of each mill shape from the domestic industry's gross shipment of that shape.

Source: Department of Commerce.

Table 11.—Distribution of wrought products

(Percent)

	1973	1974
Sheet, plate, and foil:		
Non-heat-treatable	49.7	50.2
Heat-treatable	2.9	3.6
Foil	7.1	7.1
Rolled and continuous cast rod and bar; wire:		
Rod, bar, etc	2.7	2.6
Bare wire, conductor and nonconductor	1.1	1.3
Bare cable (including steel-reinforced)	4.5	5.2
Wire and cable, insulated or covered	4.1	4.3
Extruded products:		
Rod and bar	.6	.6
Pipe and tubing	2.1	2.1
Shapes[1]	19.4	17.9
Tubing:		
Drawn	1.0	1.1
Welded, non-heat-treatable[2]	1.1	1.1
Powder, flake, and paste:		
Atomized	1.9	1.2
Flaked	([3])	([3])
Paste	.3	.2
Powder, n.e.c	.2	.2
Forgings (including impacts)	1.3	1.3
Total	100.0	100.0

[1] Includes a small amount of rolled structural shapes.
[2] Includes a small amount of heat-treatable welded tube.
[3] Less than 0.1%.

Source: Department of Commerce.

STOCKS

Reflecting the low level of demand, industry stocks of primary aluminum ingot at reduction plants increased from 62,234 tons at the beginning of the year to 145,757 tons at yearend. Although all producers do not report stocks of aluminum at reduction plants to the Bureau of Mines, the Bureau of Domestic Commerce (BDC) reported that the total metal inventory held by the aluminum industry, which includes stocks of all metal forms at reduction and other processing plants, also increased. Total industry stocks of aluminum metal, including scrap, rose from 2,183,031 tons at the beginning of the year to 2,577,768 tons at yearend.

PRICES

The primary aluminum price was under price controls at 29 cents per pound from January through March 29, 1974. Under an agreement between industry and the Cost of Living Council, the price of aluminum was decontrolled in stages through August when decontrol was completed. The price for primary aluminum was increased in successive stages to 31.5 cents per pound on March 29, 1974, to 33.5 cents per pound on June 3, to 36 cents on August 1, to 39 cents per pound on September 5, and remained at that level through the remainder of 1974.

Prices quoted by smelters for secondary aluminum alloys increased from a range of 34 to 40 cents per pound at the beginning of the year to a maximum range of 52 to 61.5 cents per pound at the end of July, and then declined to a range of 47 to 58 cents per pound at yearend.

The price range quoted for new scrap at the beginning of the year of 18.5 to 24 cents per pound rose to a maximum range of 28.5 to 35 cents per pound in April then decreased to a range of 17 to 18 cents per pound at yearend. Quotes for old scrap followed a similar pattern increasing from a range of 17 to 18 cents per pound in January to 28 to 30 cents per pound in April then declining to 11.5 to 14 cents per pound at yearend.

FOREIGN TRADE

Exports of crude and semicrude aluminum metal, including scrap, was 6.6% less than in 1973, reflecting weak world demand. Most of the decrease was accounted for by declines in exports of aluminum ingot and scrap, which were partially offset by increased exports of semimanufactured forms. As in past years, Canada was the principal recipient of U.S. aluminum exports mostly in the form of plates, sheets, and bars. Japan received most of the aluminum ingot.

U.S. imports for consumption of crude and semicrude aluminum increased slightly, and as in past years, Canada was the principal source, accounting for 80% of the crude metal and alloys and 65% of the scrap. Most of the remaining crude aluminum metal and alloys came from Ghana, and most of the remaining scrap came from the United Kingdom.

Table 12.—U.S. exports of aluminum, by class

Class	1973		1974	
	Quantity (short tons)	Value (thousands)	Quantity (short tons)	Value (thousands)
Crude and semicrude:				
Ingots, slabs, crude	229,578	$121,951	207,829	$155,817
Scrap	115,120	39,936	80,159	33,043
Plates, sheets, bars, etc	202,371	178,482	216,030	247,976
Castings and forgings	5,277	14,613	5,933	19,628
Semifabricated forms, n.e.c	8,637	15,388	14,094	26,281
Total	560,983	370,370	524,045	482,740
Manufactures:				
Foil and leaf	11,090	17,406	16,770	31,206
Powders and pastes	5,954	4,503	4,366	5,384
Wire and cable	9,194	9,457	12,274	16,526
Total	26,238	31,366	33,410	53,116
Grand total	587,221	401,736	557,455	535,856

Table 13.—U.S. exports of aluminum, by class and country

Country	1973						1974					
	Ingots, slabs, crude		Plates, sheets, bars, etc.[1]		Scrap		Ingots, slabs, crude		Plates, sheets, bars, etc.[1]		Scrap	
	Quantity (short tons)	Value (thousands)	Quantity (short tons)	Value (thousands)	Quantity (short tons)	Value (thousands)	Quantity (short tons)	Value (thousands)	Quantity (short tons)	Value (thousands)	Quantity (short tons)	Value (thousands)
Argentina	23,441	$11,639	879	$637	1	([2])	10,804	$7,190	288	$318	212	$202
Australia	1,513	917	2,042	2,492	55	$27	238	352	4,070	5,195	--	--
Belgium-Luxembourg	4,995	2,048	547	823	346	128	564	307	538	1,178	1,245	949
Brazil	6,585	3,404	2,384	2,347	5,293	2,013	16,048	14,122	4,659	6,518	4,011	1,962
Canada	34,141	18,471	91,822	83,674	9,193	2,977	39,411	28,533	102,058	117,570	10,280	3,992
Chile	240	127	13	20	20	10	792	769	125	154	3	2
Colombia	1,137	597	667	492	2	2	861	816	158	248	3	2
Denmark	4	1	5,014	4,287	--	--	1	2	3,647	4,301	--	--
El Salvador	1,414	688	760	462	--	--	2,849	2,219	378	488	1	1
France	1,869	1,041	1,705	1,946	1,456	447	2,728	2,309	1,768	2,764	1,520	886
Germany, West	21,484	11,980	9,909	15,593	14,337	4,925	4,558	2,892	10,266	14,536	10,902	5,528
Ghana	22	35	1,274	908	--	--	1	([2])	199	272	--	--
Guinea	--	--	1,305	1,108	--	--	--	--	1,481	1,354	--	--
Hong Kong	1,291	638	670	735	9	3	769	533	829	1,111	187	9
Iran	34	17	778	792	--	--	2	1	1,182	1,481	--	--
Israel	101	83	1,233	1,602	--	--	1,915	1,562	2,592	4,936	--	--
Italy	6,892	3,926	4,708	7,134	6,096	2,135	1,318	1,265	7,889	18,211	5,145	1,223
Japan	48,289	26,452	16,010	14,913	45,184	19,084	59,685	43,284	14,429	18,167	16,465	9,918
Korea, Republic of	1,490	751	276	423	10,307	2,888	2,817	1,919	1,676	1,815	1,236	686
Mexico	12,652	7,150	22,996	14,804	164	45	19,212	16,155	18,596	17,720	624	300
Netherlands	5,487	2,702	7,321	7,722	252	100	6,540	3,848	6,978	8,814	717	397
New Zealand	16	20	1,021	1,162	--	--	37	50	1,505	2,492	--	--
Norway	126	192	2,158	2,895	--	--	1,597	867	3,516	5,206	--	--
Pakistan	3,914	1,852	1,709	1,078	1,094	381	5,074	4,070	1,368	2,474	161	102
Panama	968	485	280	427	--	--	905	527	241	379	10	6
Peru	218	107	24	55	692	351	177	199	22	68	415	324
Philippines	8,921	4,742	298	449	139	78	10,293	7,410	145	388	94	81
South Africa, Republic of	36	21	4,418	4,196	--	--	21	34	4,722	5,175	--	--
Spain	764	446	605	621	1,826	369	217	219	819	1,225	552	285
Sweden	453	194	531	729	35	15	202	79	1,254	1,752	--	--
Switzerland	2,135	1,033	380	374	--	--	582	302	492	831	106	89
Taiwan	10,208	4,684	267	350	15,409	2,736	4,484	2,706	1,585	2,449	23,883	3,569
Thailand	8,611	4,698	159	170	365	247	4,880	3,483	209	310	353	238
United Kingdom	3,733	1,847	22,082	21,350	2,606	985	1,698	1,365	22,453	28,249	1,633	860
Venezuela	2,147	1,123	4,239	4,056	1	1	161	294	3,657	4,443	6	3
Other	14,297	7,895	6,351	8,162	238	94	6,903	6,144	10,798	15,798	395	1,430
Total	229,578	121,951	216,285	208,483	115,120	39,936	207,829	155,817	236,057	298,880	80,159	33,043

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[1] Includes plates, sheets, bars, extrusions, forgings, and unclassified semifabricated forms.

[2] Less than ½ unit.

Table 14.—U.S. imports for consumption of aluminum, by class

Class	1973		1974	
	Quantity (short tons)	Value (thousands)	Quantity (short tons)	Value (thousands)
Crude and semicrude:				
Metals and alloys, crude	r 508,184	r $225,545	508,643	$312,479
Circles and disks	7,752	5,663	5,817	5,614
Plates, sheets, etc., n.e.c	r 42,268	r 30,000	29,351	28,210
Rods and bars	r 7,313	r 5,746	10,098	11,952
Pipes, tubes, etc	1,466	1,846	815	1,713
Scrap	r 46,824	r 16,754	74,743	42,569
Total	r 613,802	r 285,554	629,467	402,537
Manufactures:				
Foil	9,184	14,610	6,818	17,259
Lead (5.5 by 5.5 inches)	(1)	82	(1)	105
Flakes and powders	219	416	428	649
Wire	602	730	986	1,313
Total	10,005	15,838	8,232	19,326
Grand total	r 623,807	r 301,392	637,699	421,863

r Revised.

(1) 1973: 2,269,800 leaves, and 132,057,391 square inches; 1974: 3,033,889 leaves, and 134,868,315 square inches.

Table 15.—U.S. imports for consumption of aluminum, by class and country

Country	1973						1974					
	Metals and alloys, crude		Plates, sheets, bars, etc.[1]		Scrap		Metals and alloys, crude		Plates, sheets, bars, etc.[1]		Scrap	
	Quantity (short tons)	Value (thousands)	Quantity (short tons)	Value (thousands)	Quantity (short tons)	Value (thousands)	Quantity (short tons)	Value (thousands)	Quantity (short tons)	Value (thousands)	Quantity (short tons)	Value (thousands)
Australia	--	--	24	$15	--	--	562	$388	9	$14	724	$395
Austria	--	--	2,119	1,799	--	--	1	([2])	2,086	2,142	--	--
Belgium-Luxembourg	--	--	21,726	14,266	--	--	50	48	11,217	10,265	145	90
Canada	r 480,255	r $189,128	r 5,149	r 4,519	r 39,820	r $14,036	408,280	247,499	3,670	4,508	48,847	25,790
France	1,003	481	9,705	6,806	--	--	2,682	2,347	6,757	5,842	--	--
Germany, West	103	57	r 1,409	r 1,692	630	287	2,391	2,072	1,922	2,528	4,719	3,392
Ghana	40,561	19,518	--	--	321	132	56,654	84,036	--	--	--	--
Greece	--	--	1,416	1,052	--	--	--	--	1,782	1,778	--	--
Hong Kong	--	--	58	39	--	--	20	18	52	51	1,477	1,035
Italy	--	--	2,433	1,781	--	--	--	--	2,594	2,483	17	14
Japan	166	124	6,331	4,902	55	20	10,177	8,380	6,556	8,065	2,538	1,686
Mexico	1,560	660	4	6	1,114	214	174	76	6	15	1,325	476
Norway	13,416	6,477	622	399	546	282	14,398	8,759	406	384	766	589
South Africa, Republic of	--	--	--	--	--	--	405	288	--	--	--	--
Spain	2	4	1,174	823	--	--	--	--	2,008	1,577	--	--
Surinam	12,258	4,754	--	--	--	--	7,609	4,385	--	--	--	--
Sweden	59	24	33	56	744	699	220	170	58	110	--	--
Switzerland	10	8	54	60	--	--	--	--	28	58	--	--
United Kingdom	r 8,673	r 4,189	294	327	660	267	3,117	2,415	508	617	8,505	5,864
Vietnam, South	--	--	--	--	--	--	473	302	--	--	776	491
Yugoslavia	--	--	5,455	4,150	--	--	1,213	1,125	6,150	6,723	428	388
Other	118	131	788	563	2,934	867	222	181	277	334	4,476	2,414
Total	r 508,184	r 225,545	r 58,794	r 43,255	r 46,824	r 16,754	508,643	312,479	46,081	47,489	74,743	42,569

r Revised.

[1] Includes circles, disks, bars, rod, plates, sheets, pipes, etc.

[2] Less than ½ unit.

WORLD REVIEW

Estimated world demand for primary aluminum rose slightly over the 1973 level. However, by yearend demand declined sharply, and primary producers in Japan, Canada, and Australia cut production levels and postponed expansion plans in order to maintain reasonable inventory levels.

Expansion plans continued in many of the less developed areas of the world where the cost of power was expected to be low. Ghana, Guinea, and Trinidad announced tentative plans for new smelters. Planning for new plants continued in Papua New Guinea, Indonesia, and India.

Table 16.—Aluminum: World production[1] by country
(Thousand short tons)

Country	1972	1973	1974 p
North America:			
Canada	r 1,012	1,038	1,110
Mexico	44	43	45
United States	4,122	4,529	4,908
South America:			
Brazil	107	128	122
Surinam	r 47	55	55
Venezuela	r 28	45	58
Europe:			
Austria	r 92	98	101
Czechoslovakia	r 47	76	77
France	r 433	396	435
Germany, East e	65	101	96
Germany, West	490	587	759
Greece	143	159	163
Hungary	75	75	76
Iceland	50	79	70
Italy	r 165	203	246
Netherlands	183	209	277
Norway	r 614	684	716
Poland[2]	112	116	112
Romania[3]	134	156	206
Spain	r 159	179	208
Sweden	r 84	90	91
Switzerland	92	94	97
U.S.S.R. e	1,380	1,500	1,580
United Kingdom	189	277	323
Yugoslavia	80	100	162
Africa:			
Cameroon	51	49	87
Ghana	159	166	173
South Africa, Republic of	58	58	82
Asia:			
Bahrain	r 69	118	126
China, People's Republic of e	150	160	160
India	197	170	138
Iran	r 7	37	57
Japan[4]	r 1,119	1,216	1,289
Korea, Republic of	17	18	20
Taiwan	35	39	35
Turkey	--	([5])	([5])
Oceania:			
Australia	227	228	242
New Zealand	97	127	120
Total	r 12,133	13,393	14,517

e Estimate. p Preliminary. r Revised.

[1] Output of primary unalloyed ingot unless otherwise specified.

[2] Includes secondary.

[3] Includes alloys.

[4] Includes super-purity aluminum as follows in short tons: 1972—6,313; 1973—6,526; 1974—6,206.

[5] Turkey was credited with an estimated production of 10,000 tons of aluminum in 1973 in the previous edition of this chapter; information now available suggests that output, if any in 1973, was less than 10,000 tons; production (if any) in 1974 is as yet unreported and no reliable basis is available for estimating output level.

Table 17.—World producers of primary aluminum

(Thousand short tons)

Country, company, plant location	Capacity, yearend 1974	Ownership
NORTH AMERICA		
Canada:		
Aluminium Company of Canada, Ltd.:		Alcan Aluminium Ltd., 100%.
Arvida, Quebec	458	
Beauharnois, Quebec	52	
Isle Maligne, Quebec	130	
Kitimat, British Columbia	300	
Shawinigan Falls, Quebec	95	
Total	1,035	
Canadian Reynolds Metals Co. Ltd.: Baie Comeau, Quebec	175	Reynolds Metals Co., 100%.
Total Canada	1,210	
Mexico: Alumínio S.A. de C.V.: Vera Cruz	50	Aluminum Co. of America 44.3%; Intercontinental 25.7%; Mexican interests, 16%; American and foreign interests, 14%.
United States (see table 3)	4,916	
Total North America	6,176	
SOUTH AMERICA		
Argentina: Alumínio Argentino S.A. (Aluar): Puerto Madryn	40	FATE 51%; Alcan Aluminium Ltd. 8%; Kaiser Aluminum & Chemical Corp. 8%; Péchiney Ugine Kuhlmann Group 8%; private interests 24%; Government, 1%.
Brazil:		
Alumínio Minas Gerais, S.A.:		Alcan Aluminium Ltd. 100%.
Aratü, Bahia	15	
Saramenha, Ouro Prêto	35	
Companhia Brasileira de Alumínio S.A.: Sorocaba, São Paulo	44	Industria Votorantim, Ltd. 80%; Government 20%.
Companhia Mineira de Alumínio, S.A.: Poços de Caldas, Minas Gerais	33	Hanna Mining Co. 40%; private interest 10%; Aluminum Co. of America 50%.
Total Brazil	127	
Surinam: Suriname Aluminium Co. (Suralco): Paranam	73	Aluminum Co. of America 100%.
Venezuela: Alumínio del Caroni, S.A. (Alcasa): Puerto Ordaz, Matanzas	55	Reynolds Metals Co. 50%; Government 50%.
Total South America	295	
EUROPE		
Austria:		
Salzburger Aluminium GmbH (SAG): Lend, Salzburg	13	Swiss Aluminium Ltd. 100%.
Vereinigte Metallwerke Ranshofen-Berndorf, A.G. (VMRB): Ranshofen, Braunau-am-Inn	89	Government 100%.
Total Austria	102	
Czechoslovakia: Ziar Aluminium Works: Ziar-on-Hron	72	Government 100%.
France: Péchiney Ugine Kuhlmann Group (PUK):		Self 100%.
Auzat, Ariége	33	
Chedde, Haute-Savoie	9	
L'Argentiére, Haute-Alpes	42	
La Praz, Savoie	4	
La Saussaz, Savoie	13	
Lannemezan, Haute-Pyrénées	63	
Noguères, Basses-Pyrénées	127	
Rioupéroux, Isére	26	
St. Jean de Maurienne, Savoie	91	
Sabart, Ariége	26	
Venthon, Savoie	28	
Total France	462	
Germany, East: Electrochemisches Kombinat:		Government 100%.
Bitterfeld	55	
Lautawerk	33	
Total Germany, East	88	

Table 17.—World producers of primary aluminum—Continued

(Thousand short tons)

Country, company, plant location	Capacity, yearend 1974	Ownership
EUROPE—Continued		
Germany, West:		
Aluminium-Hütte Rheinfelden GmbH: Rheinfelden, Baden	61	Swiss Aluminium Ltd. 99.85%.
Gebrueder Giulini GmbH: Ludwigshafen	50	Self 100%.
Kaiser-Preussag Aluminium GmbH: Voerde	71	Kaiser Aluminum & Chemical Corp. 50%; Preussag A.G. 50%.
Leichtmetall GmbH: Essen	139	Metallgesellschaft A.G. 50%; Swiss Aluminium Ltd. 50%.
Reynolds Aluminium Hamburg GmbH: Hamburg	110	Reynolds International, Inc. 90%; City of Hamburg 10%.
Vereinigte Aluminium-Werke A.G. (VAW):		Government 100%.
Elbewerk, Stade	72	
Erftwerke, Grevenbroiche	40	
Innwerke, Toging	77	
Lippenwerke, Lunen	55	
Norf, Rheinwerke	155	
Total Germany, West	830	
Greece: Aluminium de Grèce S.A. (ADG): Distomon	160	Péchiney Ugine Kuhlmann Group 90%; Government 10%.
Hungary: Magyarsoviet Bauxite Ipar:		Government 100%.
Ajka	19	
Inota	33	
Tatabanya	17	
Total Hungary	69	
Iceland: Icelandic Aluminium Co.: Hafnarfjordur	84	Swiss Aluminium Ltd. 100%.
Italy:		
Alcan Alluminio Italiano S.p.A.: Borgo-Franco d'Ivrea	4	Alcan Aluminium Ltd. 100%.
Alluminio Sarda S.p.A. (Alsar): Porto Vesme	138	Government 94%; Montecatini-Edison 6%.
Alumetal S.p.A.:		Government 94%; Montecatini-Edison 6%.
Bolzano	66	
Fusina	40	
Mori	26	
Societá Alluminio Veneto per Azioni S.p.A. (SAVA):		Swiss Aluminium Ltd. 50%; Government 50%.
Fusina	33	
Porto Marghera	33	
Total Italy	340	
Netherlands:		
Aluminium Delfzijl N.V. (Aldel): Delfzijl	106	Holland Aluminium N.V. 100%.
Péchiney Nederland N.V.: Vlissingen (Flushing)	94	Péchiney Ugine Kuhlmann Group 85%; Hunter-Douglas 15%.
Total Netherlands	200	
Norway:		
A/S Ardal og Sunndal Verk (ASV):		Government 50%; Alcan Aluminium Ltd. 50%.
Ardal	194	
Høyanger	33	
Sunndalsora	132	
Det Norske Nitridaktieselskap (DNN):		Alcan Aluminium Ltd. 50%; British Aluminium Co. 50%.
Eydehavn	16	
Tysseldal	27	
Lista Aluminiumverk A/S (Elkem): Lista	62	Aluminum Co. of America 50%; Elkem-Spigerverket 50%.
Mosjøen Aluminiumverk A/S (Mosal): Mosjøen	105	Aluminum Co. of America 50%; Elkem-Spigerverket 50%.
Norsk Hydro A/S Karmøy Fabrikker (Alnor): Karmøy Island	132	Norsk Hydro 100% (Government 50%).
Søer-Norge Aluminium A/S (Soral): Husnes	77	Swiss Aluminium Ltd. 75%; Compadec 25%.
Total Norway	778	

Table 17.—World producers of primary aluminum—Continued

(Thousand short tons)

Country, company, plant location	Capacity, yearend 1974	Ownership
EUROPE—Continued		
Poland: Ministry of Heavy Industry:		Government 100%.
Konin Works	61	
Skawina Works	61	
Total Poland	122	
Romania: Slatina	132	Government 100%.
Spain:		
Alumínio de Galicia, S.A.:		Péchiney Ugine Kuhlmann Group 66%; Endasa 17%; Government 17%.
La Coruña	75	
Sabiñánego, Huesca	15	
Empresa Nacional del Alumínio, S.A. (ENDASA):		Government 50.5%; Alcan Aluminium Ltd. 25%; Banco de Bilboa 15%; Spanish interests 9.5%.
Aviles	88	
Valladolid	26	
Total Spain	204	
Sweden: Gränges Aluminium AB: Kubikenborg, Sundsvall	95	Gränges AB 79%; Alcan Aluminium Ltd. 21%.
Switzerland:		
Swiss Aluminium Ltd. (Alusuisse):		Self 100%.
Chippis, Valais	35	
Steg, Valais	53	
Usine d' Aluminium Martigny, S.A.:		Self 100%.
Martigny	12	
Total Switzerland	100	
U.S.S.R.:		Government 100%.
Bogoslovsk (Krasnoturinsk) Sverdlovskaya Oblast, Urals	154	
Bratsk, Irkutskaya Oblast, Siberia	220	
Irkutsk (Shelekovo) Irkutskaya Oblast, Siberia	220	
Kamensk-Ural'skiy, Sverdlovskaya Oblast, Urals	154	
Kanaker (Yerevan), Armenia	83	
Kandalaksha, Murmanskaya Oblast	33	
Krasnoyarsk, Krasnoyarskiy Kray, Siberia	220	
Nadvoitsy, Karelskaya, A.S.S.R	39	
Novokuznetsk (Stalinsk) Kemeroyskaya Oblast, Siberia	138	
Sumgait (Kirovabad), Azerbaijan	83	
Volgograd (Stalingrad) Volgogradskaya Oblast	135	
Volkhov (Zvanka), Leningrad Oblast	22	
Zaporozhye (Dneprovsk) Zaporozhskaya Oblast, Ukraine	77	
Total U.S.S.R	1,578	
United Kingdom:		
Alcan (U.K.) Ltd.: Lynemouth, Northumberland	132	Alcan Aluminium Ltd. 100%.
Anglesey Aluminium Ltd.: Holyhead, New Wales, Scotland	112	Rio Tinto Zinc Corp. Ltd. 47%; Kaiser Aluminum & Chemical Corp. 34%; Insulated Calendars Cables Ltd. 19%.
The British Aluminium Co., Ltd. (BACO):		Tube Investments Ltd. 49%; Reynolds Metals Co. 48%.
Invergordon, Scotland	112	
Kinlochleven, Scotland	11	
Lochaber (Ft. William), Scotland	32	
Total United Kingdom	399	
Yugoslavia:		Government 100%.
Kidricevo, Slovenia	55	
Lozovac, Croatia	7	
Mostar	88	
Titograd, Montenegro	55	
Sibenik (Boris Kidric)	83	
Total Yugoslavia	288	
Total Europe	6,103	

Table 17.—World producers of primary aluminum—Continued

(Thousand short tons)

Country, company, plant location	Capacity, yearend 1974	Ownership
AFRICA		
Cameroon: Compagnie Camerounaise de l'Aluminium Péchiney Ugine (Alucam): Edea	61	Péchiney Ugine Kuhlmann Group 60%; Cobeal 10%; Comal Cie. 30%.
Ghana: Volta Aluminium Co., Ltd. (VALCO): Tema	169	Kaiser Aluminum & Chemical Corp. 90% Reynolds Metals Co. 10%.
South Africa, Republic of: Alusaf (Pty.) Ltd.: Richards Bay	85	Industrial Development Corp. (Government) and Private South African interests 78%; Swiss Aluminium Ltd. 22%.
United Arab Republic: Nag Hamadi	36	Government 100%.
Total Africa	351	
ASIA		
Bahrain: Aluminium Bahrain (ALBA)	132	Kaiser Aluminum & Chemical Corp. and British Metals 17% each; Western Metals 8.5%; Bretton Investments 5.1%; Electro-Kopper 12%; Bahrain Government 40.4%.
China, People's Republic of:		Government 100%.
Fushun, Kiaoning	60	
Changchun, Chilin		
Changsha, Hunan	160	
Hefei, Anhwei		
Hunan, Hunan		
Jiaozuo, Honan		
Lanchow, Kansu		
Taiyuan, Shansi		
Tsingtao, Shantung		
Wuhan, Hupei		
Total China, People's Republic of	220	
India:		
Aluminium Corp. of India Ltd. (Aluco): Asanol, West Bengal	10	Self 100%.
Bharat Aluminium Co. Ltd. (Balco): Korba, Madhya Pradesh	28	State Government 100%.
Hindustan Aluminium Corp. Ltd. (Hindalco): Renukoot, Uttar Pradesh	105	Kaiser Aluminum & Chemical Corp. 27%; Birla and Indian interests 73%.
Indian Aluminium Co. Ltd. (Indal):		Alcan Aluminium Ltd. 65%; Indian interests 35%.
Belgaum, Bombay	73	
Alupuram, Kerala	21	
Hirakud, Orissa	25	
Madras Aluminium Co. Ltd. (Malco): Mettur, Madras	28	Montecatini-Edison 27%; Madras State Government 73%.
Total India	290	
Iran: Iranian Aluminium Co. (IRALCO): Arak	50	Iranian Government 82.5%; Reynolds Metals Co. 12.5%; Pakistani Government 5%.
Japan:		
Mitsubishi Chemical Industries, Ltd.:		Self 100%.
Naoestu	176	
Sakaide	102	
Mitsui Aluminium Industry Co.: Omuta	88	Self 100%.
Nippon Light Metal Co., Ltd. (NLM):		Alcan Aluminium Ltd. 50%; Japanese interests 50%.
Kambara	123	
Kokkaido (Tomakomai)	143	
Niigata	159	
Showa Denko K.K.:		Self 100%.
Chiba	176	
Kitakata	47	
Omachi	46	
Sumitomo Chemical Co. Ltd.:		Self 100%.
Isoura	88	
Kikumoto	18	
Nagoya	60	
Toyama	208	
Total Japan	1,434	
Korea, Republic of: The Daehan Aluminum Co. (Han Huk): Ulsan	20	Korean Development Bank 50%; Péchiney Ugine Kuhlmann Group 50%.

Table 17.—World producers of primary aluminum—Continued

(Thousand short tons)

Country, company, plant location	Capacity, yearend 1974	Ownership
ASIA—Continued		
Taiwan: Taiwan Aluminum Corp. (Talco): Kaohsiung, Takao	42	Government 100%.
Turkey: Etibank: Seydisehir	66	Government 100%.
Total Asia	2,254	
OCEANIA		
Australia:		
Alcan Australia, Ltd.: Kurri-Kurri, New South Wales	50	Alcan Aluminium Ltd. 70.5%; other interests 29.5%.
Alcoa of Australia Pty. Ltd.: Point Henry, Victoria	110	Aluminum Co. of America 51%; Australian interests 49%.
Comalco Industries Pty. Ltd.: Bell Bay, Tasmania	105	Kaiser Aluminum & Chemical Corp. 45%; Conzinc Rio Tinto of Australia Ltd. 45%; other interests 10%.
Total Australia	265	
New Zealand: New Zealand Smelters Ltd.: Bluff	123	Comalco Industries, Pty. Ltd. 50%; Sumitomo Chemical Co. 25%; Showa Denko K.K. 25%.
Total Oceania	388	
Total world	15,567	

Argentina.—The Alumínio Argentino S.A. (ALUAR) smelter in Puerto Madryn came onstream in July. The Futaleufu hydroelectric project was not completed, and production of aluminum during 1974 was only 3,300 tons. Expansion of output to 110,000 tons per year was scheduled by mid-1975 with the addition of two gas-fired turbogenerators. The completion of the Futaleufu River hydroelectric complex in 1977 will permit production at planned capacity of 165,000 tons per year.

Australia.—Comalco Industries Pty. Ltd. delayed a 22,000-ton-per-year expansion at its Bell Bay, Tasmania, smelter. The new capacity was rescheduled to come onstream in 1976 instead of October 1975 as previously planned. Decreased demand forced Comalco to cut production at the 105,000-ton-per-year smelter by 9.5%.

Brazil.—Aluminio Brasileiro (Albras) announced plans to construct an aluminum complex in Belém. Included in the plans were an 88,000-ton-per-year smelter and an alumina refinery. Plans to develop the hydroelectric power potential of the Tocantins River continued. The smelter reportedly could be expanded to 704,000 tons per year by 1985.

Other expansions planned in Brazil included an increase to 31,000 tons per year at the Aluminium Co. of Canada, Ltd. (Alcan), smelter at Aratü by the second half of 1975 and possibly doubling of capacity to 62,000 tons per year by 1977. Cia. Brasileira de Alumínio announced plans to expand its Sorocaba plant to 77,000 tons per year by 1976 and to 121,000 tons per year by 1979.

Canada.—On July 8, 1974, Nippon Light Metal Co., Ltd. (NLM), and Alcan Aluminum Ltd. announced the formation of Alpac. The companies plan to produce 100,000 tons per year of primary aluminum at Alcan's Kitimat, British Columbia, smelter starting in 1977. Part of the alumina for the project will be supplied by NLM through a 100,000-ton-per-year contract with Comalco Industries Pty. Ltd., and the remainder will be supplied by Alcan's Jamaican and Australian refineries. The aluminum production will be split equally by the two partners. Due to the formation of Alpac, Alcan announced the expansion of the Kitimat smelter by 25,000 tons per year to 325,000 tons per year. The expansion was scheduled to come onstream in early 1976.

Lack of demand for primary aluminum at the end of 1974 forced Alcan to cut production by 100,000 tons per year or 10% of its Canadian capacity at the end of 1974.

Canadian Reynolds Metals Co. Ltd., reportedly was considering a 150,000-ton-per-year expansion at its Baie Comeau, Quebec, smelter. Capacity of the plant is currently 175,000 tons per year. Reynolds also was considering building a smelter in Newfoundland because of the relatively low cost of power. A hydroelectric plant at Churchill Falls, Labrador, and another under construction at Gull Island would supply power. Total power availability from the facilities was estimated at 6,825 megawatts. The government of Newfoundland reportedly insisted that fabricating facilities also be built in order to employ a larger portion of the population.

Egypt.—The Egyptian smelter at Nag Hamadi reportedly came onstream in 1974 with an initial capacity of 110,000 tons per year, to be expanded to 187,000 tons per year in 1975. Additional power may be required since the Nile has an uneven water level throughout the year. The U.S.S.R reportedly loaned Egypt $15 million toward the planned expansion and will take 75% of the aluminum production.

Germany, West.—Reynolds International, Inc. 110,000-ton-per-year smelter in Hamburg operated at a 27,000- to 33,000-ton-per-year level in 1974 as the result of a court order stemming from charges that the smelter did not meet fluoride emission standards. In 1975, the jurisdictional court was scheduled to take up the question of whether full-capacity operations would meet the antipollution standards.

Ghana.—A 50,000-ton-per year expansion was reportedly underway at the Volta Aluminium Co., Ltd. (VALCO) smelter in Tema. The expansion plans include raw materials storage facilities and improvements to the four existing potlines. Kaiser Engineers, Inc., was chosen to design and construct the expanded facilities, which should be completed by spring 1976. The cost of the improvements was estimated at $65 million. VALCO is owned by Kaiser Aluminum & Chemical Corp. (90%) and Reynolds Metals Co. (10%).

Kaiser and Ardeco, a consortium of five Japanese steelmakers, were reportedly undertaking a feasibility study for a 660,000-ton-per-year alumina refinery and a 110,000-ton-per-year smelter. Bauxite for the project would be supplied by Ghana.

Guinea.—The Governments of Guinea and Romania signed a preliminary agreement for a smelter to be built in Guinea by the two countries and for a hydroelectric project to be built by Romania.

Guyana.—The Governments of Guyana, Trinidad and Tobago, and Jamaica announced plans to build a smelter in Guyana. Construction was scheduled to start in January 1978 with completion of a 200,000-ton-per-year smelter expected in 1981. The Essequibo County hydroelectric plant was to supply the power. Guyana had 52% interest in the project with the remaining interests held by Jamaica (24%) and Trinidad and Tobago (24%).

India.—Power shortages resulting from severe droughts cut production at the Hindustan Aluminium Corp. Ltd. (Hindalco) smelter at Renukoot and the Madras Aluminium Co. Ltd. plant at Mettur. The Madras smelter reached capacity production of 28,000 tons per year at the end of 1974. Hindalco's plant was held at less than the 105,000-ton-per-year capacity level by the energy shortage and slowdowns resulting from labor differences.

The first stage of the Bharat Aluminium Co. Ltd. smelter at Korba, Madhya Pradesh, was scheduled to come onstream in 1975 with a 28,000-ton-per-year capacity level. Expansions were scheduled to continue until the plant achieved 110,000-ton-per-year capacity.

Plans for a new smelter in the Kohlapur district of Marashtra were announced by the Association of Aluminium Industries.

Indonesia.—Construction of the Asahan smelter in North Sumatra was scheduled to start in 1975. The initial capacity of 247,000 tons per year was to be expanded to 396,000 tons per year later. Cost of the smelter was estimated at $350 million, which was to be financed primarily by the Japanese Government. Power was to be supplied by a planned 500-megawatt hydroelectric plant on the Asahan River.

Iran.—The Iranian Aluminium Co. (IRALCO) announced tentative plans to increase the Arak smelter capacity from 50,000 tons per year to 120,000 tons per year by 1978. The cost was estimated at $50 million. Alumina for the plant was supplied by India.

Japan.—Oversupply due to lack of demand resulted in Japanese producers delaying several expansion startups. Nippon Light Metal Co., Ltd., deferred startup of a 44,000-ton-per-year potline at Niigata until September 1975. The expansion that was completed in 1974 raised the capacity of the smelter to 159,000 tons per year.

Mitsubishi Chemical Industries, Ltd.,

postponed indefinitely the startup of a 50,000-ton-per-year potline at Sakaide. Startup had originally been scheduled for March 1975. Other deferred expansion startups included the Sumitomo Chemical Co. Ltd., smelter at Toyo and the Mitsui Aluminium Industry Co. plant at Miike. Showa Denko K.K. postponed for 1 year the addition of a 50,000-ton-per-year potline at its Chiba smelter. The expansion, which will raise the capacity of the smelter to 210,000 tons per year of aluminum, was scheduled to come onstream in the fall of 1976.

The expansion by 87,000 tons per year to 175,000 tons per year of aluminum at the Mitsui Aluminium Industry Co. Omuta smelter was on schedule, with about half the new capacity due onstream in early 1975 and the remaining half 1 year later.

The start of construction of the Sumikei Aluminum Co. projected 180,000-ton-per-year aluminum smelter at Sakata in Yamagata was deferred until spring 1975. Furukawa Aluminium Co. Ltd. expected to satisfy pollution control requirements by the end of 1974 and to start construction in 1975 on the Mikuni aluminum smelter in Fukuni.

Sumitomo Chemical Co. Ltd., cut production by 10% at Toyama, Isoura, and Nagoya smelters in order to reduce inventories.

Korea, Republic of.—Tsvetmetpromexport of the U.S.S.R. and Ilosolbi of South Korea reportedly signed a contract for delivery of equipment and construction of a 25,000-ton-per-year aluminum smelter in Pukchang.

Mexico.—Plans were being formulated for a 120,000-ton-per-year aluminum smelter in Mexico. Alumina for the $90 million plant was to be supplied by Jamaica. Tentative partners in the smelter reportedly included the Mexican Government (51%), the Jamaican Government (29%), and Kaiser Aluminum & Chemical Corp. (20%).

Norway.—The Norwegian Government acquired Alcan Aluminium's 50% share in A/S Årdal og Sunndal Verk for $62 million on January 1, 1975. Under the agreement, Alcan will continue to supply the plant with alumina as well as to receive ingot.

Norsk Hydro A/S Karmøy Fabrikker announced tentative plans to build a second primary aluminum plant on Karmøy Island. Plans call for an initial capacity of 50,000 tons per year to be expanded to 80,000 tons per year over an extended period. The existing smelter has a capacity of 132,000 tons per year.

Det Norske Nitridaktieselskap (DNN) encountered problems with the Norwegian Government over pollution controls on the tentative expansion of the Tysseldal facility. The Government reportedly would prefer that a new, more competitive plant be built. DNN was also said to have encountered problems of financing the 20,000-ton-per-year expansion.

Papua New Guinea.—The Governments of Papua New Guinea and Australia and several Japanese companies reportedly undertook a feasibility study for a large aluminum smelter to be constructed in Niugini. The three groups also announced the consolidation of plans for a $1.5 billion hydroelectric project on the Purari River at Wabo.

Philippines.—Reynolds Metals Co. and the Philippine Government reportedly signed a letter of intent to build an aluminum smelter. Reynolds was to provide technical assistance in the design and construction of the facility. The proposed 110,000-ton-per-year plant, which was to be built near Ormoc, would use geothermal power.

Spain.—Alumina Espanola announced a change in location of its proposed alumina/aluminum complex because of possible pollution problems. The site was changed to San Cipriano in Jove-Cerro of Lugo Province. Construction was scheduled to start in 1975 with the plant due onstream in 1978. The company is owned by the State-owned Instituto Nacional de Industria (55%) and Alugasa Pechiney (45%).

Aluminio de Galicia, S.A. increased the production capacity of its La Coruña smelter by 14,000 tons per year to 75,000 tons per year. Further expansion was planned.

Sweden.—Gränges Aluminium AB announced plans to expand the capacity of its Sundsvall smelter by 52,000 tons per year to 147,000 tons per year. The furnaces will use a new process designed to lower energy requirements and to reduce pollution problems. Cost of the expansion was estimated at $75 million.

Taiwan.—Taiwan Aluminium Corp. announced plans to expand the current 42,-

000-ton-per-year capacity of its Kaohsiung smelter to 77,000 tons per year by the end of 1975. Additional planned expansions include 20,000 tons per year by 1978 and further expansion to 350,000 tons per year by 1983. Cost of the 1975 expansion was estimated at $52.6 million.

Trinidad.—The consortium composed of Trinidad and Tobago (34%), Guyana (33%), and Jamaica (33%) announced plans for a 200,000-ton-per-year smelter at Point Lisas, Trinidad. Trinidad was to supply natural gas as fuel and Yugoslavia would finance the project. Construction on the $350 million smelter was scheduled to start in January 1976 with startup planned for late 1977. Guyana and Jamaica would supply alumina.

U.S.S.R.—The Péchiney Ugine Kuhlmann Group confirmed a preliminary contract with the U.S.S.R. agreeing to build an alumina/aluminum complex at Sainsk. The 500,000-ton-per-year smelter will include semifabricating facilities, aluminum fluoride facilities, and a carbon anode plant. A 1-million-ton-per-year alumina refinery to be built on the Black Sea coast, 6,000 miles from the Sainsk smelter, was planned. Total cost of the project was estimated at $1 billion.

The Bratsk smelter was scheduled to be expanded to 385,000 tons per year in 1975. Additional facilities at the Krasnoyarsk smelter, which receives its power from the Angara Power Dam, were reported completed during 1974.

Venezuela.—Construction of the New Venalum smelter in Puerto Ordaz, Matanzas, began. Startup was scheduled for July 1977 with an initial capacity of 77,000 tons per year to be expanded later to 308,000 tons per year. The plant will be operated by Alumínio del Caroni, S.A. (Alcasa), owned 50% by Reynolds Metals Co. and 50% by Corporación Venezolana de Guyana (CVG), a government corporation. New Venalum is owned by CVG (80%), Showa Denko K.K. (7%), Kobe Steel (4%), Sumitomo Chemical (4%), Mitsubishi Kasei and Mitsubishi Metal (4%), and Marubeni (1%). The Japanese firms were scheduled to receive 176,000 tons per year of the expanded output.

Yugoslavia.—The 88,000-ton-per-year primary aluminum smelter at Mostar came onstream in 1974 with full production expected in 1975. Alumina was eventually to be supplied by the Bacevici refinery. The Péchiney Ugine Kuhlmann Group provided technical assistance on the project.

The first stage of the Boris Kidric smelter operated at 75,000 tons per year during 1974. A power shortage idled 56 cells during part of the year.

Zaire.—Reynolds Metals Co. announced a feasibility study for a primary smelter based on power from the Inga Dam. Alumina for the plant will be produced from local bauxite. Kobe Steel and Nippon Light Metals have reportedly expressed interest in the project.

TECHNOLOGY

The 1973 oil embargo and subsequent rise in energy costs inspired increased research and development to produce aluminum with better energy efficiency. In June 1974, a conference of industry and government representatives was held at Cambridge, Mass., to exchange information on energy use patterns in aluminum production and recycling processes and to recommend ways of improving energy efficiency of the processes. The conference was sponsored jointly by The Aluminum Association, the Center for Materials Science and Engineering of the Massachusetts Institute of Technology, and the Bureau of Mines. An overview of the results of the conference was published.[6]

Emphasis at the conference was placed on the energy required for producing alumina using the Bayer process, for reducing the alumina to metal by the Hall-Heroult process, and for melting and recycling operations.

Based on thermodynamics calculations, the theoretical energy requirement in the Bayer processes was given as 610,000 British thermal units (Btu) per short ton of alumina produced from bauxite. However, due to the losses of waste heat, practical energy requirements reportedly ranged from about 10 million to 22 million Btu per ton of alumina. Areas for significant potential improvement of the Bayer process included: (1) Reducing heat losses in existing equipment, (2) increasing the product yield, (3) using regenerative heating wherever possible, (4) reducing heat discharged with red mud, and (5) using fluid-bed calcination in place of rotary kiln.

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[6] Aluminium. Conference on Energy Conservation and Recycling in the Aluminum Industry, Cambridge 1974. February 1975, pp. 178–182.

Average electrical requirements of the Hall-Heroult reduction step to produce a short ton of aluminum from alumina was given as 8 kilowatt-hours per pound, equivalent to about 55 million to 176 million Btu per ton, depending on whether the electric energy used was from hydrogenerating or from thermal-generating plants.

Significant reduction of the energy required in the Hall-Heroult reduction process was believed to be possible through basic research on the chemistry of the electrolyte, the electrolysis mechanism, and heat and fluid flow in the cell as influenced by thermal, gravitational, and electromagnetic forces in the cell. Development of permanent (nonconsumable) anodes and wettable cathode materials also were believed to be promising areas for research.

Although the industry average requirement of electricity in the conventional Hall-Heroult cell in 1974 was about 8 kilowatt-hours per pound of aluminum, a new plant using Hall-Heroult cells designed by Alcoa and operated by Anaconda was mentioned that utilized only 6.6 to 6.85 kilowatt-hours per pound. Péchiney was said to have operated an experimental Hall-Heroult type cell at 5.7 to 5.85 kilowatt-hours per pound. These latter figures show an efficiency comparable with the energy efficiency expected to be achieved at a new 15,000-ton-per-year plant based on electrolysis of aluminum chloride being built at Palestine, Tex., by Alcoa, which was expected to use 30% less energy in the reduction step than the Hall-Heroult cells.

Major energy savings could be achieved by avoiding as much remelting of metal as possible by using the hot metal, directly from the reduction cells, in continuous rod or sheet mills or in casting operations. About 1 million Btu per ton is theoretically required to melt aluminum compared with the present industry practice of about 4 to 12 million Btu per ton depending on furnace efficiency and the form of aluminum metal melted. Fuel consumption and thermal efficiencies of various remelt furnaces were given as follows:

	Fuel consumption, (Btu/lb)	Thermal efficiency, (percent)
Conventional furnaces-melt controlled	2,000–3,000	17–40
Charging box furnaces-2 chamber melt with salt cover	3,000–6,000	10–23
Rotary furnaces with molten salt	3,300–4,500	12–16
Induction furnaces, 60-cycle, 1,200 to 1,500 kilowatts:		
Hydroelectric source	860– 935	53–67
Thermal source	2,580–2,805	18–19

The summary report on the conference indicated that heat and material losses from remelting operations could be reduced by: (1) Consistent use of better methods to recover metal from dross and skimmings, (2) reduction of metal oxidation, (3) reduction of the quantity of in-house scrap that is generated, (4) recycling heat from casting operations, (5) avoiding large temperature gradients by mixing the molten metal, and (6) using oxygen enrichment.

The Aluminum Association provided the Bureau of Mines with results of a comprehensive study it conducted on energy use patterns of the domestic aluminum industry in 1972 and 1973. Based on data provided by its members, the Association aggregated the total use of fuels and electric energy by the aluminum industry to produce bauxite, alumina, and primary aluminum metal in the United States. Estimates of the fuels used by others to generate electricity that was purchased by the aluminum industry also were included. The energy used in producing aluminum ingot and mill shapes also was covered in the study, but that used by the secondary aluminum industry and aluminum foundries was for the most part excluded.

As shown in table 18 the energy data were aggregated by the type of energy used in five functional categories of the aluminum production cycle: (1) Bauxite (mining); (2) alumina (production); (3) hot metal production; (4) holding, casting, and melting; and (5) fabrication. Factors used by the Association to convert the different types of fuels and energy to a common energy unit, the Btu, are given in table 19.

Table 18.—Energy consumption by the aluminum metal industry in the United States[1]
(Billion Btu)

Form of energy used	Bauxite	Alumina	Hot metal production	Holding, casting, melting	Fabrication	Total
1972						
Natural gas	127	98,141	20,520	46,919	61,520	227,227
Propane and liquefied petroleum gas (LPG)	6	1	358	983	1,287	2,635
Distillate oils	36	168	497	2,119	1,027	3,847
Residual oils	--	8,932	1,322	3,551	2,289	16,094
Lube and rolling oils	4	21	359	239	4,955	5,578
Gasoline and kerosine	10	46	266	87	342	751
Petroleum coke[2]	--	--	51,449	--	--	51,449
Pitch[2]	--	--	16,099	--	--	16,099
Coal and other	--	--	2,504	432	3,570	6,506
Electricity—hydro[3]	--	838	89,303	681	9,027	99,849
Electricity—thermal[3]	51	6,113	139,810	1,177	12,075	159,226
Energy content of fuels used to generate electricity less the thermal equivalent of the electricity produced from such sources	105	11,910	310,609	2,493	25,094	350,211
Total	339	126,170	633,096	58,681	121,186	939,472
1973						
Natural gas	80	101,785	21,835	50,089	61,709	235,498
Propane and liquefied petroleum gas (LPG)	6	--	471	1,142	1,621	3,240
Distillate oils	45	114	722	1,990	1,347	4,218
Residual oils	1	8,263	1,178	2,966	1,500	13,908
Lube and rolling oils	5	25	379	248	4,893	5,550
Gasoline and kerosine	10	49	243	95	494	891
Petroleum coke[2]	--	--	63,111	--	--	63,111
Pitch[2]	--	--	18,977	--	--	18,977
Coal and other	--	--	1,764	466	3,800	6,030
Electricity—hydro[4]	--	989	92,077	773	10,587	104,426
Electricity—thermal[4]	51	6,379	160,193	1,341	12,826	180,790
Energy content of fuels used to generate electricity less the thermal equivalent of the electricity produced from such sources	102	12,732	350,362	2,848	26,713	392,757
Total	300	130,336	711,312	61,958	125,490	1,029,396

[1] Excludes most secondary aluminum operations and aluminum foundries. See text and other footnotes for detailed explanation of data.

[2] Direct usage by aluminum industry. Anodes purchased from others are excluded.

[3] Includes both purchased and self-generated electricity. Total is thermal equivalent of 75.9 billion kilowatt-hours electricity used (1 kilowatt-hour=3,413 Btu).

[4] Includes both purchased and self-generated electricity. Total is thermal equivalent of 83.6 billion kilowatt-hours electricity used (1 kilowatt-hour=3,413 Btu).

Source: The Aluminum Association, Inc.

Table 19.—Conversion factors used by the Aluminum Association for fuels and energy

	Unit	Thermal equivalent, Btu per unit
Fuels or energy:		
Natural gas	cubic foot	1,027
Propane	gallon	91,547
Other liquefied petroleum gas	do	102,032
Distillate oils	do	138,700
Residual oils	barrel	6,287,000
Lube and rolling oils	gallon	139,400
Gasoline	do	127,650
Kerosine	do	135,000
Petroleum coke	ton	30,059,760
Pitch	do	30,059,760
Lignite	do	12,700,000
Bituminous coal	do	24,000,000
Anthracite coal	do	24,000,000
Hydroelectric energy	kilowatt-hour	3,413
		Thermal equivalent of fuels required to generate electricity, Btu per kilowatt-hour
Electricity:		
Generated from hydropower	kilowatt-hour	--
Generated from thermal energy sources:		
Purchased:		
Coal	do	10,500
Gas	do	10,500
Oil	do	10,500
Nuclear energy	do	10,500
Self-generated:		
Fossil fuels (1972)	do	11,648
Fossil fuels (1973)	do	11,473

Source: The Aluminum Association, Inc.

Energy used to mine metallurgical-grade bauxite and to produce alumina for subsequent reduction to metal is included under the bauxite and alumina categories, respectively. However, energy used to mine and produce special grades of bauxite and alumina for refractory, abrasive, and chemical uses is excluded. Energy used by the aluminum industry to produce lime and caustic is included under the alumina category if such materials were used to make alumina for aluminum metal production.

The hot metal production category includes electricity used in electrolytic cells to reduce the alumina to metal and the energy content of the coal, oil, gas, lignite, and nuclear fuels used to generate part of the electricity used by the industry, whether purchased or self-generated. In addition, the energy content of fuels used to make carbon anodes and cathodes as well as the energy content of carbon materials in the electrodes themselves, is included. Energy used by the aluminum industry to calcine green petroleum coke or to produce fluorides or cryolite used in producing metallic aluminum, also is included in the hot metal category. Energy used by others to produce purchased items (except electricity) is not included.

The holding, casting, and melting category includes energy used for holding furnace, ingot casting, and melting operations in the United States, whether located at the smelter or at fabricating plants. This category includes all operations immediately prior to any continuous casting operations such as for sheet and rod. Remelt operations are included. However, energy used for soaking, annealing, or heat treatment of mill products was included in the fabrication category.

The fabrication category includes energy used for the production of aluminum mill shapes beyond the ingot casting stage. Mill products include sheet, plate, and foil; extrusions, drawn tube, and welded tube; rod, bar, wire, and electrical conductor wire and cable; forgings and impacts; and powder and paste. Fuel used for intracompany shipping of products, if such fuel was purchased by members of the aluminum industry for use in company-owned carriers, and for some other miscellaneous fabricating uses also is included.

The energy content of purchased materials, such as carbon electrodes, alloying ingredients, packaging materials, plastics, adhesives, paints or coatings, plastic wire and cable coverings or insulation, and fuels consumed by a service business for the aluminum industry, such as noncompany common carriers, is not included.

Data in table 20 show fuel and hydropower use patterns for the industry's electrical power needs in 1972 and 1973. Of the 83.6 billion kilowatt-hours of electricity used by the aluminum industry in 1973, 36.6% was from hydroelectric facilities, and the remainder was thermally generated at an average efficiency from all fuel sources of 31.5%.

According to The Aluminum Association, Inc. total energy use per unit declined in 1973 relative to that in 1972. Inasmuch as both total industry production and total energy use in 1973 was greater than that in 1972, an expression of the improved energy efficiency in 1973 was derived by the Association by calculating the total energy that would have been used in 1973 if the use per unit in 1973 had been the same as that in 1972. This calculation indicated an overall energy savings by the aluminum industry in 1973 of 14.5 trillion Btu. This quantity of energy is equivalent to that contained in about 2.5 million barrels of oil.

Table 20.—Sources of electric energy used by the aluminum industry in the United States

Energy source	1972			1973		
	Electricity used [1] (billion kilowatt hours)	Thermal equivalent of electricity used [2] (billion Btu)	Total fuel used to generate electricity used [3] (billion Btu)	Electricity used [1] (billion kilowatt hours)	Thermal equivalent of electricity used [2] (billion Btu)	Total fuel used to generate electricity used [3] (billion Btu)
Hydropower	29.3	99,849	--	30.6	104,426	--
Coal	29.0	99,059	313,434	34.4	117,301	367,849
Natural gas	15.6	53,349	175,272	16.1	54,970	179,689
Oil	1.3	4,410	13,304	1.5	5,048	15,828
Nuclear	.7	2,413	7,427	1.0	3,471	10,681
Total	75.9	259,080	509,437	83.6	285,216	578,547

[1] Includes both self-generated and purchased electricity used by the aluminum industry.

[2] Thermal equivalent of 1 kilowatt-hour is equal to 3,413 Btu.

[3] Includes the thermal equivalent of thermally-generated electricity. Data include fuel used by aluminum companies for self-generation as well as estimated fuel usage by utilities to generate the electricity purchased by the aluminum industry. Self-generation fuel usage is based on reported efficiencies; purchased electricity fuel usage is measured at 10,500 Btu per kilowatt-hour and based on reported patterns of fuel usage by utilities from whom the electricity was purchased.

Source: The Aluminum Association, Inc.

Results of an intensive investigation of air pollution control methods available to the aluminum industry and the impact on the industry of the cost of controlling air emission of gases and solids from primary aluminum production facilities, within proposed standards, were published.[6]

Eight commercial metal producers joined the Bureau of Mines as cosponsors of research on extracting aluminum from domestic materials, to reduce dependence on imports. Using experimental miniplant facilities at the Bureau's Boulder City Metallurgy Research Laboratory in Nevada, several methods for producing alumina from plentiful domestic sources will be investigated. Most of the alumina from which aluminum metal is produced in the United States is presently made from imported bauxite. The aluminum companies cooperating with the Bureau on the miniplant project are Alcoa; Aluminium Co. of Canada, Ltd.; Amax Aluminum Co., Inc., Anaconda Aluminum Co.; Consolidated Aluminum Corp.; Kaiser Aluminum & Chemical Corp.; Martin Marietta Aluminum, Inc.; and Reynolds Aluminum Co. Each corporation is paying $50,000 per year over the next 3 years, and the Bureau is paying $400,000 per year. Costs for setting up the miniplant and for its first year of operation were paid entirely by the Bureau.

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[6] Environmental Protection Agency. Background Information for Standards of Performance: Primary Aluminum Industry Volume 1: Proposed Standards. Office of Air and Waste Management, October 1974, 99 pp.

The miniplant is designed to convert roughly 70 pounds of an aluminum-bearing clay to 25 pounds of alumina per hour, using a nitric acid leaching process. Hydrochloric acid leaching of clay will be tested next. The facility runs around the clock, so that particular processing techniques having commercial promise can be evaluated and adjustments can be made, as needed, for improved efficiency.

When the experiments on clay are complete, new miniplant facilities being installed at Boulder City, Nev., will process anorthosite, alunite, and dawsonite in future stages of the program. Each of these aluminum-bearing minerals is plentiful in the United States.

Antimony

By Charlie Wyche [1]

Antimony was in short supply during the early months of 1974, although the recent upward trend in domestic mine production was maintained. The high demand for antimony, particularly antimony trioxide, resulted in major price increases and some slowdown in usage by consuming industries. The alltime high metal price turned previously uneconomical deposits into viable ore bodies that are currently being developed. The New York price of domestic antimony metal, RMM brand, rose from $0.94 per pound in January to $2.25 in June. The $2.25 per pound remained in effect through yearend. A 12% decline in consumption was undoubtedly related to the high price of antimony materials.

Domestic mine production rose for the second successive year, but primary smelter production declined moderately below the 1973 figure. Imports were up, continuing the fluctuating pattern that began in 1968.

Legislation and Government Programs.—At yearend Government stocks of antimony totaled 40,734 tons, of which 18,705 tons was in the national stockpile and 22,029 tons was in the supplemental stockpile. The stockpile objective for antimony has been reduced to zero, therefore the total inventory was excess.

The depletion allowance was 22% for domestic production and 14% for domestic companies engaged in foreign mining. There was no import tariff on antimony ore, and duty during 1974 was 0.1 cent per pound on crude antimony metal and 1.0 cent per pound on unwrought refined metal.

Table 1.—Salient antimony statistics

(Short tons)

	1970	1971	1972	1973	1974
United States:					
Production:					
Primary:					
Mine	1,130	1,025	489	545	661
Smelter [1]	13,381	11,374	13,344	17,206	16,657
Secondary	21,424	20,917	22,428	24,062	23,570
Exports of ore, metal, and alloys gross weight	543	1,023	121	515	871
Imports, general	18,654	13,595	23,748	21,265	22,119
Consumption	13,937	13,707	16,124	20,613	18,041
Price: New York, average cents per pound	144.19	71.18	59.00	68.50	181.76
World: Production	77,124	70,658	r 73,986	r 76,744	77,751

r Revised.

[1] Includes primary antimony content of antimonial lead produced at primary lead refineries.

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[1] Physical scientist, Division of Nonferrous Metals.

DOMESTIC PRODUCTION

MINE PRODUCTION

Domestic production of antimony in 1974 increased 21% to 661 tons, despite a reduction in domestic consumption. As in recent years, most of the metal (445 tons) was recovered as a byproduct from processing silver-lead-copper ore by the Sunshine Mining Co., Coeur d'Alene district, Idaho. Sunshine's output was 38% above that of 1973, reflecting a steady return to normal operation following several years of below average production. Byproduct antimonial lead recovered at primary lead smelters from domestic lead ores totaled 658 tons, significantly below the 1973 level. This material contained 8.8% antimony and was consumed as antimonial lead.

The U.S. Antimony Corp. located at Thompson Falls, Mont., completed expansion of its facilities during 1974, and both production and the number of antimony products are expected to increase. The company rebuilt its ore crushing facilities and moved into a new building. A 300-ton-per-day-capacity ball mill and additional flotation cells were added. A large furnace and a dust control system were installed in the antimony refinery. Currently, the company produces a 93%- to 95%-grade metal, but is upgrading the process to produce a 99.5%-grade metal and also antimony trioxide. Production in 1974, however, declined from the 1973 level. The decline was attributed to interruptions caused by the expansion program. Most of U.S. Antimony's mine output came from its Babbit mine.

Table 2.—Antimony mine production and shipments in the United States
(Short tons)

Year	Antimony concentrate (quantity)	Antimony	
		Produced	Shipped
1970	6,681	1,130	1,029
1971	4,721	1,025	1,073
1972	2,072	489	547
1973	2,468	545	494
1974	3,217	661	593

Four mines in Nevada produced and shipped antimony concentrates containing 47 tons of antimony. Most of the concentrates were processed to metal at the Intermountain Smelting Corp. in Salt Lake City, Utah.

SMELTER PRODUCTION

Primary.—Primary smelter output decreased 3% in relation to that of 1973, with oxide, sulfide, and byproduct antimonial lead registering losses. However, smelter production of metal and residues increased 6% and 12%, respectively. The source of feed materials for the smelters was as follows: 91% from foreign antimony ores and base metal ores, and 9% from domestic mine production of antimony concentrate and as a byproduct at domestic lead smelters. Byproduct antimony recovered at lead refineries represented 8% of the total primary antimony output. Virtually all of the byproduct antimony was consumed at the refineries in manufacturing antimonial lead. A small quantity was used to prepare oxide or processed to residues. Smelter production of primary products, in ratios approximating those of 1973, were as follows: Metal, 18%; oxide, 63%; sulfide and residues, 13%; and byproduct antimonial lead, 6%.

The NL Industries, Inc. smelter in Texas, Sunshine Mining Co. in Idaho, U.S. Antimony Corp. in Montana, and Intermountain Smelting Corp. in Utah produced antimony metal. Oxide was produced by American Smelting and Refining Company (ASARCO) Inc., Harshaw Chemical Co., M & T Chemicals Inc., and U.S. Antimony Corp. The Bunker Hill Co., ASARCO, and St. Joe Minerals Corp. produced byproduct antimonial lead. Antimony sulfide was produced by McGean Chemical Co. Inc., and M & T Chemicals Inc.

Table 3.—Primary antimony produced in the United States
(Short tons, antimony content)

Year	Class of material produced					Total
	Metal	Oxide	Sulfide	Residues	Byproduct antimonial lead	
1970	3,732	8,261	23	384	981	13,381
1971	3,816	6,272	18	136	1,132	11,374
1972	3,837	8,343	232	201	731	13,344
1973	2,859	11,273	92	1,839	1,143	17,206
1974	3,030	10,445	54	2,066	1,062	16,657

Table 4.—Byproduct antimonial lead produced at primary lead refineries in the United States
(Short tons)

Year	Gross weight	Antimony content				
		From domestic ores [1]	From foreign ores [2]	From scrap	Total	
					Quantity	Percent
1970	20,438	598	383	203	1,184	5.8
1971	19,686	828	304	59	1,191	6.0
1972	15,051	516	215	319	1,050	7.0
1973	15,455	731	412	24	1,167	7.6
1974	12,518	658	404	35	1,097	8.8

[1] Includes primary residues and a quantity of antimony ore.
[2] Includes foreign base bullion and small quantities of foreign antimony ore.

Secondary.—Antimonial lead recovered from scrap in 1974 totaled 23,570 tons, about 500 tons less than in 1973. Secondary smelters recovered 20,561 tons, primary smelters recovered 35 tons, and manufacturers and foundries recovered the remaining 2,974 tons. Old scrap, predominantly battery plates, generated about 87% of the secondary output; new scrap, mostly in the form of drosses and residues from various sources, supplied the remaining 13%. The scrap processed was essentially all from domestic sources. A percentage breakdown of old scrap by source was as follows: Batteries, 65%; type metal, 15%; babbitt, 11%; all other material, 9%. Drosses made up 9% of the new scrap, and residues supplied 5%. Approximately 2,000 tons of primary antimony was used to supplement secondary metal to meet commercial requirements; this was about 275 tons less than in 1973.

Table 5.—Secondary antimony produced in the United States, by kind of scrap and form of recovery
(Short tons, antimony content)

Kind of scrap	1973	1974
New scrap:		
Lead-base	3,527	2,950
Tin-base	62	43
Total	3,589	2,993
Old scrap:		
Lead-base	20,459	20,561
Tin-base	14	16
Total	20,473	20,577
Grand total	24,062	23,570

Form of recovery	1973	1974
In antimonial lead [1]	19,212	18,963
In other lead alloys	4,842	4,597
In tin-base alloys	8	10
Total	24,062	23,570
Value (millions)	$33.0	$85.7

[1] Includes 24 tons of antimony recovered in antimonial lead from secondary sources at primary plants in 1973 and 35 tons in 1974.

CONSUMPTION AND USES

Reflecting a tight supply and high prices, total consumption of antimony decreased 8% from the 1973 level of 44,675 tons to 41,041 tons. Antimony from primary sources accounted for 44% of the total (18,041 tons), and secondary metal contributed 56% (23,000 tons). Antimony oxide represented 53% of the raw material used, and antimony metal the remaining 47%. As shown in table 7, the nonmetals products section was separated into two parts to reflect more clearly the use of primary antimony in flame retardants. Secondary antimony, recovered chiefly from battery scrap, was used in the manufacture of antimonial lead and other hard-lead alloys.

Consumption of primary antimony in metal products decreased 12% in relation to 1973. In the largest use category, antimonial lead, requirements for antimony were down 10%. Consumption in bearings, sheet and pipes, castings, and type metal was also well below the 1973 level. Other uses such as cable covering, collapsible tubes, and solder showed small gains.

The consumption of antimony trioxide fell 15%. The 51% rise in oxide used in flame retardants failed to offset a 38% drop in other nonmetal products. In the nonmetal products section, antimony trioxide consumption was down in all subsections except one. Uses in ceramics and glass, pigments, and plastics showed the largest decline, reflecting a slowdown in the building industry. Higher demand for flame retardants resulted from stricter fire codes and a shift toward clothing made from materials that require flameproofing. The use of antimony trioxide in flame retardant is growing rapidly every year, and demand will continue to be high.

Of some 1,300 tons of antimony classified under "Other" nonmetal products, about 71% was used as sodium antimonate. This compound is used as an opacifier in enamel frits to add hardness and increase acid resistance. About 18% was consumed as chemicals, antimony sulfide, and antimony chloride (penta- and trichloride); the remaining 11% was used in other industrial applications.

Table 6.—Industrial consumption of primary antimony in the United States by class of material consumed

(Short tons, antimony content)

Year	Ore and concentrate	Metal	Oxide	Sulfide	Residues	Byproduct antimonial lead	Total
1970	380	4,989	7,157	46	384	981	13,937
1971	387	5,080	6,944	28	136	1,132	13,707
1972	1,226	5,473	8,389	104	201	731	16,124
1973	582	5,824	10,970	255	1,839	1,143	20,613
1974	1,032	4,362	9,457	62	2,066	1,062	18,041

Table 7.—Industrial consumption of primary antimony in the United States, by class of material produced

(Short tons, antimony content)

Product	1970	1971	1972	1973	1974
Metal products:					
Ammunition	102	67	64	122	121
Antimonial lead	5,246	5,430	6,149	8,027	7,251
Bearing metal and bearings	481	515	559	527	476
Cable covering	38	36	19	12	16
Castings	16	20	39	65	31
Collapsible tubes and foil	35	22	20	12	18
Sheet and pipe	77	74	108	97	69
Solder	286	178	177	191	205
Type metal	220	177	142	134	107
Other	73	102	105	104	135
Total	6,574	6,621	7,382	9,291	8,429

Table 7.—Industrial consumption of primary antimony in the United States, by class of material produced—Continued

(Short tons, antimony content)

Product	1970	1971	1972	1973	1974
Nonmetal products:					
Ammunition primers	27	28	23	18	11
Fireworks	17	4	4	5	11
Ceramics and glass	1,820	1,840	1,695	1,917	1,384
Pigments	610	592	644	644	460
Plastics	1,667	1,810	2,391	2,920	1,431
Rubber products	519	525	587	693	664
Other	929	768	1,118	2,219	1,268
Total	5,589	5,562	6,462	8,416	5,229
Flame retardant[1]:					
Plastics	1,774	1,524	2,280	2,906	2,711
Pigments					172
Rubber					252
Adhesives					231
Textiles					980
Paper					87
Total	1,774	1,524	2,280	2,906	4,383
Grand total	13,937	13,707	16,124	20,613	18,041

[1] Flameproofing chemicals and compounds shown separately by use starting 1974.

STOCKS

Industrial stocks of antimony totaled 11,694 tons at yearend, a 16% increase over the record level for 1973. Oxide increased, but metal stocks declined. The overall increase was due to large unused Government stocks purchased by industry in 1973.

Table 8.—Industry stocks of primary antimony in the United States, December 31

(Short tons, antimony content)

Stocks	1970	1971	1972	1973	1974
Ore and concentrate	2,973	3,582	3,562	5,585	6,275
Metal	1,598	1,367	1,332	1,540	809
Oxide	2,932	2,697	3,179	2,074	3,732
Sulfide	39	22	182	31	35
Residues and slags	948	647	176	526	549
Antimonial lead[1]	357	322	191	322	294
Total	8,847	8,637	8,622	10,078	11,694

[1] Inventories from primary sources at primary lead refineries only.

PRICES

The U.S. dependence on antimony imports and the high worldwide demand for the metal resulted in a continuing upward trend in domestic prices. The four price increases that occurred in 1974 advanced RMM brand antimony metal from $0.94 to $2.25 per pound, New York, by mid-June. The record $2.25-per-pound price level remained in effect through yearend. The Lone Star grade increased to a record high of $2.67 during the same period. At the beginning of 1974, quotations for 60% European lump ores were $22.50 to $24.50 per short ton unit; yearend quotations were $31.30 to $32.20. The refusal of the People's Republic of China to make any significant quantities of antimony available at its Canton Fairs was a prime factor in the high prices. The quoted price range per pound of antimony oxide in late December was $1.84 to $2.16, up from $1.24 at the beginning of the year.

Table 9.—Antimony price ranges in 1974

Type of antimony	Price per pound
Domestic metal[1]	$0.92–$2.28
Foreign metal[2]	.90– 3.50
Antimony trioxide[3]	.87– 2.16

[1] RMM brand, f.o.b., Laredo, Tex.
[2] Duty-paid delivery, New York.
[3] Quoted in Metals Week.

FOREIGN TRADE

Exports of antimony material in 1974 totaled 1,464 tons, of which 593 tons was oxide and 871 tons was metal alloys, scrap, and waste. The 1974 combined value of $2,681,509 was more than 5 times the 1973 total. The large increase in value was due primarily to inflated prices for materials rather than an actual increase in the volume of exports. More than 35 countries, led by the Netherlands, Canada, the United Kingdom, Spain, and the Republic of Korea, accounted for around 97% of the metal, scrap, waste, and alloys exported. Oxide exports totaled 593 tons, 53% above those of 1973. The value of oxide totaled $1,049,980, and consignments were made to 18 countries. Canada was the leading recipient with 170 tons, followed by West Germany with 99 tons, and 74 tons went to the United Kingdom. The remaining 250 tons was distributed among 15 other countries.

General imports of antimony in various forms increased 4% to 22,119 tons. Imports of ore and concentrates declined to the lowest quantity since 1971, largely because of a combined drop of 34% from Bolivia, Turkey, and the Republic of South Africa. Increased receipts from Guatemala, Thailand, and the United Kingdom failed to offset the decrease from the major sources. With the processing of some of the Republic of South Africa ore to oxide, and Bolivia ore to metal, imports of ore from these countries can be expected to continue to decline. Because of oxide and metal production by these countries, imports of oxide increased from 4,600 to 6,300 tons (gross weight) and metal imports from 700 to 2,300 tons. Yugoslavia, the People's Republic of China, Mexico, and Japan were the principal sources for metal imports (76%). The United Kingdom and France supplied 57% of the oxide.

In addition to imports of ore, metal, and oxide, 565 tons of alloys containing antimony was imported. Belgium-Luxembourg and Thailand supplied 55% and 15% of this material, respectively. The Netherlands, Czechoslovakia, and Italy furnished most of the remainder. Total value of this material was $1.7 million.

Table 10.—U.S. imports for consumption of antimony, by country

Country	1973		1974	
	Quantity (short tons)	Value (thousands)	Quantity (short tons)	Value (thousands)
Antimony metal including needle or liquated:[1]				
Austria	--	--	(2)	$2
Belgium-Luxembourg	61	$89	142	489
Brazil	33	20	17	45
Canada	1	24	1	27
China, People's Republic of	180	225	492	1,993
Czechoslovakia	--	--	30	117
France	--	--	(2)	(2)
Germany, West	1	19	(2)	43
Italy	--	--	56	204
Japan	3	4	239	1,085
Korea, Republic of	--	--	22	101
Mexico	141	51	442	435
Netherlands	11	20	6	11
Spain	34	55	22	73
Sweden	(2)	(2)	--	--
Taiwan	--	--	32	117
Thailand	--	--	86	307
Turkey	32	36	11	47
United Kingdom	180	203	132	488
U.S.S.R	--	--	2	7
Yugoslavia	66	72	557	2,230
Total	743	818	2,289	7,821

See footnotes at end of table.

Table 10.—U.S. imports for consumption of antimony, by country—Continued

Country	1973 Quantity (short tons)	1973 Value (thousands)	1974 Quantity (short tons)	1974 Value (thousands)
Antimony oxide:				
Belgium-Luxembourg	410	$557	499	$1,540
Canada	3	5	66	132
China, People's Republic of	314	348	93	311
France	1,225	1,467	1,334	3,325
Germany, West	([2])	([2])	32	172
Italy	--	--	46	166
Japan	220	276	990	3,733
Netherlands	33	37	88	351
South Africa, Republic of	--	--	805	229
Taiwan	33	30	20	81
U.S.S.R	45	57	33	50
United Kingdom	2,368	3,323	2,263	5,490
Total	4,651	6,095	6,269	15,580

[1] Includes needle or liquated (value in thousands): 1973—Belgium-Luxembourg 41 tons ($57), United Kingdom 10 tons ($16); 1974—Belgium-Luxembourg 56 tons ($174), United Kingdom 30 tons ($97).

[2] Less than ½ unit.

Table 11.—U.S. imports for consumption of antimony ore, by country

Country	1973 Gross weight (short tons)	1973 Antimony content (short tons)	1973 Value (thousands)	1974 Gross weight (short tons)	1974 Antimony content (short tons)	1974 Value (thousands)
Belgium-Luxembourg	--	--	--	353	112	$242
Bolivia	5,939	3,662	$2,807	4,380	2,669	3,969
Brazil	232	153	121	76	82	57
Canada	386	248	213	50	10	16
Chile	2,520	1,590	1,104	3,683	2,283	2,915
Colombia	111	52	11	110	16	15
France	--	--	--	1,928	386	347
Guatemala	586	296	82	1,489	745	308
Honduras	32	12	9	285	105	97
Iran	23	13	4	--	--	--
Malaysia	--	--	--	164	61	99
Mexico	7,099	2,088	563	6,638	1,629	781
Morocco	--	--	--	929	421	861
Mozambique	1,102	657	531	--	--	--
Netherlands	--	--	--	190	76	159
Peru	161	80	57	--	--	--
Rhodesia	--	--	--	396	259	369
South Africa, Republic of	11,375	6,446	4,410	7,878	4,739	8,481
Thailand	88	36	19	1,361	619	1,525
Turkey	4,205	1,339	960	816	201	164
United Kingdom	10	7	12	659	292	461
Total	33,869	16,679	10,903	31,330	14,655	20,866

Table 12.—U.S. imports for consumption of antimony

Year	Antimony ore Gross weight (short tons)	Antimony ore Antimony content (short tons)	Antimony ore Value (thousands)	Needle or liquated Gross weight (short tons)	Needle or liquated Value (thousands)	Antimony metal[1] Gross weight (short tons)	Antimony metal[1] Value (thousands)	Antimony oxide Gross weight (short tons)	Antimony oxide Value (thousands)
1972	33,542	17,212	$9,437	78	$75	2,302	$2,092	5,032	$5,766
1973	33,869	16,679	10,903	51	73	692	745	4,651	6,095
1974	31,330	14,655	20,866	86	271	2,203	7,550	6,269	15,580

[1] Does not include alloy containing 83% or more of antimony: 1972—Mexico 87 short tons ($79,294), the United Kingdom, 31 short tons ($25,327), Taiwan, 11 short tons ($31,693); 1973—the United Kingdom, 57 short tons ($59,854), Mexico, 21 short tons ($19,858), Belgium-Luxembourg, 20 short tons ($20,216), Canada, 2 short tons ($2,875); 1974—Belgium-Luxembourg, 311 short tons ($883,224), Thailand, 83 short tons ($293,901), the Netherlands, 44 short tons ($31,988), Czechoslovakia, 38 short tons ($138,804), Italy, 33 short tons ($142,831), Yugoslavia, 16 short tons ($71,572), Turkey, 16 short tons ($41,332), Canada, 15 short tons ($48,014), Japan, 6 short tons ($21,711), Mexico, 3 short tons ($908).

WORLD REVIEW

World mine production of antimony in 1974 increased marginally to 77,700 tons from 76,700 tons in 1973. However, output in both the Republic of South Africa and Bolivia declined. The demand was high in most consuming countries, and many small producers increased production, offsetting the drop recorded by the major producers. The overall increase was due to the worldwide mine development and expansion plan that began in 1972.

Australia.—The Australian Antimony Corp. N.L. mine at Dorrigo, on the north coast of New South Wales, produced about 400 tons of antimony ore per day. The company purchased Broken Hill Antimony, Pty. Ltd., whose plant at Attanga, near Dorrigo, was used to process the ore. Reserves were estimated at 535, 000 tons. The company had a pilot plant in operation at Taylor's Arms, also near Dorrigo.

New England Antimony, Pty. Ltd., operated an antimony mine and mill at Hillgrove, near Armidale, in the New England district of New South Wales. Silver Valley Ltd. also developed a stibnite orebody at Hillgrove. The nearby Tulloch treatment plant was reconditioned to treat the ore.

Le Grand Minerals Ltd. investigated an antimony prospect at Mount Misery, in North Queensland. Reserves were estimated at 164,000 tons averaging 1% antimony. Metromar Minerals Ltd. and Australian Anglo-American Ltd. started the second phase of their exploration and evaluation program at the Blue Spec Gold prospect in the Pilbara region of Western Australia. Drilling results indicate ore reserves of 240,000 tons averaging 6% antimony. Initial plans call for a 200-ton-per-day mine and mill. The project, when completed, will cost $1.5 to $3 million.

Bolivia.—Work was reportedly proceeding as scheduled on construction of the antimony smelter begun by Skoda Export of Czechoslovakia in 1973. Production was scheduled to begin in 1975 at the 5,000-ton-per-year plant, which will also produce 1,000 tons per year of antimony trioxide.

Canada.—The only antimony mine in Canada was owned by Consolidated Durham Mines and Resources Ltd. It mines low-angle-dipping veins containing stibnite at its Lake George property near Fredericton, New Brunswick. The mine has four levels with the bottom level 450 feet below the surface. The mill, with an operating rate of between 150 and 200 tons per day, produced concentrates averaging over 65% antimony, which was shipped to smelters in the United States, Japan, and Europe.

India.—The Star Metal Refinery Private, Ltd., Bombay, remained the sole importer and processor of antimony ores and concentrates. Efforts to develop a domestic source of mineable antimony at Chikkannanahalli, Chitaldrug District, and Mysore was continuing.

Japan.—The Hibino Metal Co., Japan's largest antimony producer, started operation at its Banpin, Thailand, plant in June. Production started at 150 tons per month from reserves containing 500,000 tons of antimony. The company also imported 100 tons of antimony per month from Sarawak, Malaysia. The two supply sources accounted for 60% of Hibino's needs.

South Africa, Republic of.—Consolidated Murchison Ltd. operated at capacity; milling of 622,000 tons of ore provided 24,750 tons of antimony concentrate. This was slightly higher than the 619,000 tons milled in 1973, which provided 25,365 tons of concentrate. The antimony content of the concentrate averaged 60.13% in 1974.

Diamond drilling from the surface during the year totaled 10,800 feet, compared with 30,000 feet drilled during 1973. Surface drilling was confined to targets within the established mine working area, namely, from Alpha in the west to Monarch in the east, and was aimed principally at finding new ore bodies.

Antimony Products Pty. Ltd. started its new 3,500-ton-annual-capacity antimony beneficiation plant in Gravelotte, Transvaal, South Africa. Antimony Products is a joint venture of Chemetron Corp. (Chicago), Consolidated Murchison Ltd. (Johannesburg), and Johannesburg Consolidated Investment Co. Ltd. Antimony ore is upgraded by Antimony Products to an 83% crude antimony oxide prior to shipment. Chemetron received the facility's full output, approximately 25% of the output of the nearby Consolidated Murchison Mines. First shipments arrived in Chemetron's processing facility in Cleveland, Ohio, in July.

Thailand.—Progress continued on the $1.2 million antimony project located at Lampany Province (Northern Thailand) by Amco Metal Industries Corp.

Table 13.—Antimony: World production (content of ore unless otherwise indicated), by country
(Short tons)

Country	1972	1973	1974 [p]
North America:			
Canada[1]	340	947	[e] 1,380
Guatemala	992	961	[e] 990
Honduras	33	53	149
Mexico[2]	3,280	2,632	2,653
United States	489	545	661
South America:			
Argentina	[r] 348	1	[e] 220
Bolivia	[r] [3] 14,703	[3] 16,372	[4] 14,396
Ecuador	10	22	[e] 22
Peru (recoverable)[2]	[r] 826	849	[e] 880
Europe:			
Austria (recoverable)	553	593	595
Czechoslovakia[e]	660	660	770
Italy	1,324	1,497	[e] 1,400
Portugal	15	22	--
Spain	152	126	304
U.S.S.R.[e]	7,700	7,800	8,000
Yugoslavia	2,177	2,265	[e] 2,240
Africa:			
Algeria[e]	66	66	70
Morocco	917	1,249	2,360
Rhodesia, Southern[e]	220	220	220
South Africa, Republic of	16,062	17,306	16,866
Asia:			
Burma	144	158	183
China, People's Republic of[e]	13,000	13,000	13,000
Japan	(5)	(5)	--
Korea, Republic of	3	12	[e] 10
Malaysia (Sarawak)	226	276	[e] 280
Pakistan[e]	50	15	33
Thailand	5,208	3,763	4,669
Turkey	2,982	3,696	[e] 3,750
Oceania: Australia[6]	[r] 1,506	1,638	[e] 1,650
Total	[r] 73,986	76,744	77,751

[e] Estimate. [p] Preliminary. [r] Revised.

[1] Antimony content of smelter products, excludes output from New Brunswick, which is believed to be small.

[2] Antimony content of ores for export plus antimony content of antimonial lead and smelter products produced.

[3] Production by COMIBOL plus exports of medium and small miners.

[4] Total exports.

[5] Revised to zero.

[6] Antimony content of antimony concentrates, lead concentrates, and zinc concentrates.

TECHNOLOGY

A process for removing antimony impurities from blister copper or copper matte by an oxygen-enriched air technique was described in a patent.[2] Initially, iron-copper scrap, scrap iron, or other oxidizable metallic iron is added to the antimony-containing melt, and the melt is treated with oxygen-enriched air. The antimony is oxidized and attached to the iron oxide, and the insoluble oxide phase is mechanically scraped from the surface of the melt.

A detailed report on the intergranular segregation of antimony associated with temper embrittlement in a low-carbon manganese steel was published.[3]

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[2] Lundquist, S. A., (assigned to Boliden AB). U.S. Pat. 3,744,992, July 10, 1973.

[3] Guttmann, M., P. R. Krahe, F. Abel, G. Amsel, M. Bruneaux, and C. Cohn. Temper Embrittlement and Intergranular Segregation of Antimony. Met. Trans., v. 5, No. 1, January 1974, pp. 167–177.

Asbestos

By Robert A. Clifton [1]

Shipments of asbestos from mines in the United States decreased 25% from the record high in 1973. Construction industry troubles and the recession were the main reasons for the decreased demand. Imports were 3% below 1973 levels.

The world's leading producer, Canada, decreased shipments to the United States, its largest market, 3% and Canada's total 1974 shipments were 97% of 1973 shipments.

Table 1.—Salient asbestos statistics

	1970	1971	1972	1973	1974
United States:					
Production (sales) short tons	125,314	130,882	131,663	150,116	112,533
Value thousands	$10,696	$12,174	$13,409	$16,288	$13,759
Exports and reexports (unmanufactured) short tons	46,585	53,678	58,624	66,442	61,723
Value thousands	$6,996	$7,863	$9,051	$9,342	$9,192
Exports and reexports of asbestos products (value) thousands	$25,391	$31,409	$32,110	$40,777	$60,396
Imports for consumption (unmanufactured) short tons	649,402	681,367	735,515	792,473	766,164
Value thousands	$75,146	$80,090	$87,732	$98,914	$123,822
Released from stockpile (unmanufactured) short tons	4,782	10,210	13,174	6,761	28,851
Consumption, apparent [1] short tons	732,913	768,781	821,728	882,908	845,825
World: Production do	r 3,846,475	r 3,951,373	r 4,163,675	4,512,032	4,535,924

r Revised.

[1] Measured by quantity produced, plus imports, plus stockpile releases, minus exports.

Legislation and Government Programs.—The Environmental Protection Agency (EPA) published clarifications and amendments to its asbestos emission standards in May. In August, the second portion of the effluent guidelines for asbestos manufacturing point sources was published. In October EPA published some controversial proposed amendments to its national asbestos emission standards. In July the Mining Enforcement and Safety Administration promulgated amendments to its Metal and Nonmetal Mines Health and Safety Standards which substituted "fiber counts" for the former "dust counts" for asbestos mines and mills. The new standards and monitoring techniques now agree with those of the Office of Safety and Health Administration (OSHA) of the Labor Department. In 1974 the General Services Administration (GSA) reduced Government inventories by disposing of 11,586 short tons of amosite, 16,890 tons of crocidolite, and 375 tons of chrysotile. Southern Rhodesian asbestos continued to arrive in the country because of the "strategic material" exception to the U.S. observance of the United Nations sanctions.

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[1] Physical scientist, Division of Nonmetallic Minerals.

Table 2.—Stockpile objectives and Government inventories as of December 31
(Short tons)

	Stockpile objectives	Total inventories		Released 1974
		1973	1974	
Amosite	None	58,179	46,593	11,586
Chrysotile	1,100	r 10,443	10,455	--
Subspecification	XX	1,528	1,153	375
Crocidolite	None	19,368	2,478	16,890
Total	XX	89,518	60,679	28,851

r Revised. XX Not applicable.

Environmental Impact.—Threatened effects of environmental regulations on the asbestos manufacturing industry again failed to materialize in 1974. The small decrease in asbestos consumption was a sign of a relatively healthy industry.

The cost of coming into compliance with environmental regulations was the announced cause of the GAF Corp.'s decision to leave the asbestos-mining industry and at least somewhat of a factor in the closing of two mines in California.

On October 15 the U.S. Supreme Court let stand a lower court decision in *Borel* v. *Fibreboard Paper Products Corp., et al.* making asbestos products manufacturers and their suppliers liable for asbestos-related diseases among workers.

DOMESTIC PRODUCTION

U.S. mines shipped only 75% as much asbestos in 1974 as in 1973. The value was only 84% of the 1973 amount. Four States produced asbestos; California, with 53%, was the leader, followed in order by Vermont, Arizona, and North Carolina. Total output was 112,533 tons valued at $13,759,000.

The California segment of the asbestos industry led the sharp decline in U.S. production. The closing early in the year of the Christie mine of the Coalinga Asbestos Co., Inc. was followed by the closing of the Pacific Asbestos Corp. mine. These mine closures led to production of only 57% of the 1973 State total. Only 55% of the 1973 dollar value of the fiber was realized. At yearend negotiation was underway aimed at acquisition and reopening of the Pacific Asbestos mine. Yearend mining was limited to the Joaquin Ridge near Coalinga with Atlas Asbestos Corp. working its Santa Cruz mine in Fresno County and Union Carbide Corp. operating its Santa Rita mine in San Benito County.

GAF Corp.'s mine in Orleans County, Vt., remained the U.S. asbestos mine with the highest production; its output increased significantly over that in 1973. This mine was scheduled for closure by GAF in March 1975, but at yearend it appeared that an employee group might be successful in efforts to purchase the mine and keep it operating. Arizona production in 1974 was less than a third of the 1973 level. The Jaquays Mining Corp. mine in Gila County was the only active asbestos mine in the State. The mine in North Carolina of Powhatan Mining Co. was inactive, but some shipments from stockpile were made in 1974. U.S. asbestos producers and mine sites follow:

State and company	County	Name of mine	Type of asbestos
Arizona: Jaquays Mining Corp	Gila	Chrysotile	Chrysotile.
California:			
Atlas Asbestos Corp	Fresno	Santa Cruz	Do.
Coalinga Asbestos Co., Inc [1]	do	Christie	Do.
Pacific Asbestos Corp [1]	Calaveras	Pacific Asbestos	Do.
Union Carbide Corp	San Benito	Santa Rita	Do.
North Carolina:			
Powhatan Mining Co	Yancey	Hippy	Anthophyllite.
Vermont: GAF Corp	Orleans	Lowell	Chrysotile.

[1] Closed at yearend.

CONSUMPTION AND USES

Apparent consumption in table 1 was revised to reflect stockpile adjustments; with these adjustments it reveals a 4% decrease in overall usage.

Consumption data in table 3 were obtained from a new survey form. The new options available on the form break continuity between the 1974 data and those data in table 6 of the 1973 chapter. A benefit of the new form and computer assistance in tabulation is that end use data can now be presented by grade for chrysotile. The data in table 3 have been adjusted to agree with those in table 1.

Table 3.—Asbestos distribution by end use, grade, and type, 1974

(Short tons)

	Chrysotile							
	Group 1 & 2	Group 3	Group 4	Group 5	Group 6	Group 7	Group 8	Total chrysotile
Asbestos cement pipe	--	--	92,600	20,300	--	72,300	--	185,200
Asbestos cement sheet	--	--	10,900	15,800	52,000	11,800	--	90,500
Flooring products	--	--	--	49,000	--	104,500	--	153,500
Roofing products	--	--	3,700	11,100	12,700	46,300	--	73,800
Packing and gaskets	100	1,900	7,500	7,500	1,400	10,300	--	28,700
Insulation, thermal	--	100	900	100	3,400	2,800	--	7,300
Insulation, electrical	--	--	400	1,600	--	2,700	--	4,700
Friction products	--	5,600	1,300	29,500	6,300	36,600	300	79,600
Coatings and compounds	--	--	100	400	300	36,700	400	37,900
Plastics	400	1,000	900	800	--	7,500	6,300	16,900
Textiles	700	14,200	3,900	800	--	800	--	20,400
Paper	--	--	5,500	400	23,900	33,300	--	63,100
Other	--	300	1,100	--	2,300	32,700	--	36,400
Total	1,200	23,100	128,800	137,300	102,300	398,300	7,000	798,000

	Crocidolite	Amosite	Anthophyllite	Total asbestos
Asbestos cement pipe	36,400	1,100	200	222,900
Asbestos cement sheet	--	4,300	--	94,800
Flooring products	--	--	--	153,500
Roofing products	--	1,700	--	75,500
Packing and gaskets	100	--	--	28,800
Insulation, thermal	--	1,800	--	9,100
Insulation, electrical	--	--	--	4,700
Friction products	--	--	200	79,800
Coatings and compounds	--	--	--	37,900
Plastics	200	--	700	17,800
Textiles	--	--	--	20,400
Paper	200	--	--	63,300
Other	400	500	--	37,300
Total	37,300	9,400	1,100	845,800

For the first time asbestos cement pipe as an end use has been isolated; it is the largest single user of asbestos with better than 26% of the total consumption. This was not unexpected, but that asbestos cement sheet would remain the third largest user at over 11% was a surprise. Flooring products at 18% were in the second spot. If the near 9% used in roofing products is added to the top three these construction industry products account for nearly two-thirds of U.S. asbestos use. The other major asbestos-using end products are friction materials at 9%, paper at 7% and coatings and compounds at 4%. Another newcomer to the Bureau of Mines survey is plastics, which uses better than 2% of the asbestos total.

Table 4 shows asbestos usage in the United Kingdom during 1973.

Table 4.—United Kingdom: Breakdown of asbestos fiber usage, 1973[1]
(Percent)

	Chrysotile	Amosite	Anthophyllite	Crocidolite	Total
Asbestos cement for building products	37.5	--	--	--	32.2
Asbestos cement pressure, sewage, and drainage pipes	5.3	5.0	--	--	5.2
Fire-resistant insulation boards	2.0	81.3	--	--	13.1
Insulation products, including spray	.9	11.2	--	--	2.3
Jointings and packings	7.7	--	--	--	6.6
Friction materials	11.5	--	--	--	9.9
Textile products not included in "Friction materials"	5.6	--	--	--	4.8
Floor tiles	10.9	--	--	--	9.4
Molded plastics and battery boxes	1.5	2.5	--	--	1.6
Fillers and reinforcements (felts, millboard, paper, underseals, mastics, adhesives, etc.)	17.1	--	100.0	--	14.9
Total	100.0	100.0	100.0	--	100.0

[1] Data furnished by Asbestos Information Association of North America.

Figure 1 shows variations in the average annual growth rate in demand over a span of years. These growth rates projected to the year 2000 can give demands ranging from 2.6 million tons down to 1.0 million tons.

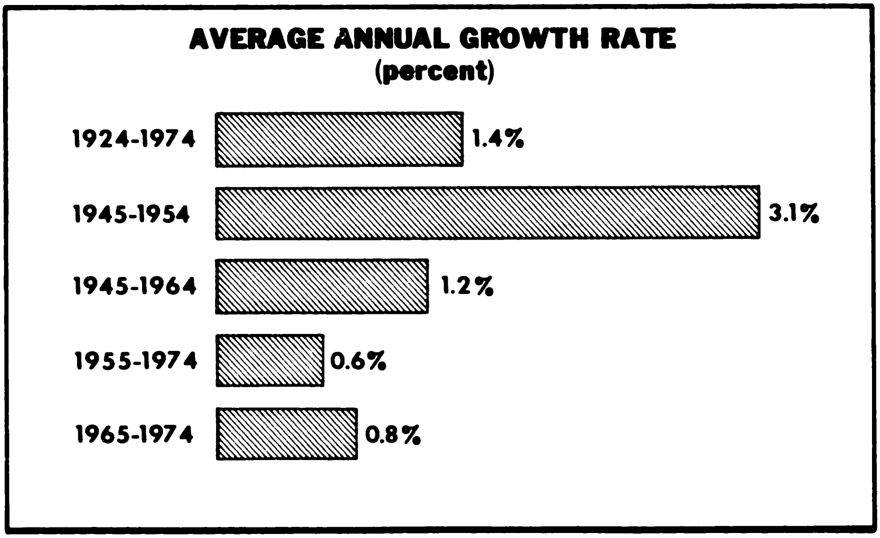

Figure 1.—U.S. asbestos demand, historical trends.

PRICES

Quoted prices for Quebec asbestos rose more than 39% during 1974 with the last rise effective on August 1, 1974. A further rise was announced effective in 1975. British Columbia asbestos prices rose more than 45% during the year in three steps, the last one also effective August 1, 1974. Another increase to start the new year was announced.

Prices for some grades of Arizona chrysotile asbestos were raised on April 1, 1974. Quotations, f.o.b. Globe, follow:

Grade	Description	Per short ton
Group No. 1	Crude	$1,750
Group No. 2	do	1,000
AAA		1,000
Group No. 3	Nonferrous filtering and spinning	$550–700
Group No. 4	Nonferrous plastic and filtering	550–600
Group No. 5	Plastic and filtering	385–425
Group No. 6	Refuse or shorts	350
Group No. 7	do	65–100

As of May 1, 1974, Vermont chrysotile asbestos, f.o.b. Morrisville, was priced as follows:

Grade	Description	Per short ton
Group No. 4	Shingle fiber	$250.00–$424.00
Group No. 5	Paper fiber	180.00–212.00
Group No. 6	Waste, stucco, or plaster fiber	131.00
Group No. 7	Shorts and floats	50.00–114.00

Quotations for Canadian (Quebec) chrysotile, f.o.b. mine, were as follows, as of August 1, 1974:

Grade	Description	Per short ton
Group No. 1	Crude	Can $2,428
Group No. 2	do	1,320
Group No. 3	Spinning fiber	$619–1,016
Group No. 4	Asbestos-cement fiber	318–576
Group No. 5	Paper fiber	214–290
Group No. 6	Waste, stucco or plaster	180
Group No. 7	Refuse or shorts	76–146

Prices for British Columbia and Yukon Territory, Canada, chrysotile asbestos were effective August 1, 1974. Quotations, f.o.b. Vancouver, follow:

Grade	Description	Per short ton
	CASSIAR MINE	
C–1	Crude	Can $2,214
AAA	Nonferrous spinning fiber	1,301
AA	do	1,034
A	do	787
AC	do	564
AK	Asbestos cement fiber	402
AS	do	349
AX	do	319
AY	do	226
AZ	do	166
	CLINTON MINE	
CP	Asbestos cement fiber	Can $380
CT	do	341
CY	do	226
CZ	do	166

African asbestos producers privately negotiate sales and this rules out market quotations. The following are averages, regardless of grade, of the values of South African imports, calculated from U.S. Department of Commerce data:

The increased demand for asbestos in all categories resulted in price increases almost across the board. Additional rises were expected early in 1975.[2]

Type	Per short ton				
	1970	1971	1972	1973 [r]	1974 [1]
Amosite	$160	$164	$187	$188	$228
Crocidolite	196	212	211	218	251
Chrysotile	198	120	202	234	282

[r] Revised.
[1] 1st 10-month data on imports, U.S. Bureau of the Census.

FOREIGN TRADE

The value of exports of asbestos products manufactured in the United States increased 48% over the value of those exported in 1973. Five of the nearly 100 countries buying these products accounted for 60% of the foreign sales. They were Canada (38%), West Germany (8%), the United Kingdom (6%), Mexico (4%), and Australia (4%).

Major groupings of exported products and their share of the total were friction products (21%), packing and gaskets (21%), asbestos cement products (18%), textiles and yarns (14%), and insulation products (8%).

In 1974 56% of the cost of imported asbestos was recovered by the exporting and reexporting of fibers and products. Only 20% of the cost of Canadian fiber was recovered from exports to Canada.

In 1974 the United States imported 91% of its asbestos needs. This was above the 1973 percentage. Canada provided better than 96% of the imports, the Republic of South Africa provided 3%, and nine other countries provided the remainder. Chrysotile, with 97%, dominated the imported types. There was a 25% increase in the dollar value of imported fibers.

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[2] Asbestos. V. 56, No. 7, January 1975, p. 28.

Table 5.—Importers of U.S. asbestos products in 1974, by type and country
(Thousand dollars)

	Canada	Germany, West	United Kingdom	Australia	Mexico	Other	Total
Friction products	7,728	560	273	594	97	3.387	12,639
Packing and gaskets	1,982	326	434	262	317	9.261	12,582
Asbestos cement products	5,385	2,498	79	85	84	2,937	11.063
Textiles and yarns	4,901	195	63	1,268	833	1,148	8,408
Insulation products	481	46	122	99	125	3,668	4,541
Other	2,255	1,007	2,738	227	759	4,037	11,023
Total	22,732	4,627	3,709	2,535	2,215	24,438	60,256

Table 6.—U.S. exports and reexports of asbestos and asbestos products

Product	1973 Quantity	1973 Value (thousands)	1974 Quantity	1974 Value (thousands)
EXPORTS				
Unmanufactured:				
Crude and spinning and nonspinning fibers ---------- short tons --	42,791	$6,604	22,633	$6,069
Waste and refuse ---------- do ----	23,109	2,647	32,481	2,574
Total ---------- do ----	65,900	9,251	55,114	8,643
Products:				
Gaskets and packing ---------- do ----	3,309	10,483	3,235	12,582
Brake linings ---------- do ----	5,813	7,863	5,924	10,136
Clutch facings, including linings number --	2,620,486	1,870	2,429,537	2,503
Textiles and yarn ---------- short tons --	9,598	6,454	9,465	8,408
Shingles and clapboard ---------- do ----	11,226	2,586	12,345	3,348
Articles of asbestos cement ---------- do ----	9,336	2,478	31,275	7,715
Protective clothing ----------	NA	462	NA	556
Insulation, heat and sound ----------	NA	2,850	NA	4,541
Manufactures, n.e.c ----------	NA	5,659	NA	10,467
Total ----------	XX	40,705	XX	60,256
REEXPORTS				
Unmanufactured:				
Crude and spinning and nonspinning fibers ---------- short tons --	438	86	2,129	548
Waste and refuse ---------- do ----	104	5	4,480	1
Total ---------- do ----	542	91	6,609	549
Products:				
Gaskets and packing ---------- do ----	8	22	5	17
Brake linings ---------- do ----	1	2	34	39
Clutch facings, including linings number --	9,600	11	14,504	21
Textiles and yarn ---------- short tons --	9	22	47	12
Shingles and clapboard ---------- do ----	--	--	28	8
Articles of asbestos cement ---------- do ----	54	15	45	5
Manufactures, n.e.c ----------	--	--	NA	38
Total ---------- short tons --	XX	72	XX	140

NA Not available. XX Not applicable.

Table 7.—U.S. imports for consumption of asbestos from specified countries, by grade

(Short tons)

Grade	1973			1974		
	Canada	Southern Rhodesia	Republic of South Africa	Canada	Southern Rhodesia	Republic of South Africa
Chrysotile:						
Crudes ----------	1,991	845	1,235	115	1,717	987
Spinning fibers ----------	15,665	--	8	26,768	4	66
All other ----------	746,988	--	3,427	712,228	--	3,291
Crocidolite (blue) ----------	--	--	12,552	--	--	11,302
Amosite ----------	--	--	7,842	--	--	8,018
Total ----------	764,644	845	25,064	739,111	1,721	23,664

Table 8.—U.S. imports for consumption of asbestos (unmanufactured), by class and country

Year and country	Crude (including blue fiber)		Textile fiber		All other		Total	
	Quantity (short tons)	Value (thousands)	Quantity (short tons)	Value (thousands)	Quantity (short tons)	Value (thousands)	Quantity (short tons)	Value (thousands)
1973								
Canada	1,991	$397	15,665	$6,020	746,988	$86,449	764,644	$92,866
Finland	--	--	--	--	1,027	93	1,027	93
Germany, West	79	21	--	--	--	--	79	21
Guyana	--	--	--	--	303	8	303	8
Italy	--	--	--	--	8	3	8	3
Malagasy, Republic	--	--	--	--	3	1	3	1
Mexico	--	--	--	--	43	7	43	7
Mozambique	51	27	--	--	5	1	56	28
Panama	--	--	--	--	12	11	12	11
Portugal	--	--	--	--	1	(1)	1	(1)
Rhodesia, Southern	845	423	--	--	--	--	845	423
South Africa, Republic of	21,629	4,510	8	1	3,427	733	25,064	5,244
Swaziland	200	122	130	73	--	--	330	195
Yemen	--	--	--	--	50	11	50	11
Yugoslavia	--	--	--	--	8	3	8	3
Total	24,795	5,500	15,803	6,094	751,875	87,320	792,473	98,914
1974								
Brazil	--	--	--	--	20	2	20	2
Canada	115	13	26,768	10,416	712,228	106,085	739,111	116,514
Finland	--	--	--	--	557	74	557	74
Germany, West	99	35	--	--	1	1	100	36
Italy	--	--	1	4	--	--	1	4
Mexico	--	--	--	--	55	11	55	11
Portugal	--	--	--	--	4	2	4	2
Rhodesia	1,717	1,010	4	2	--	--	1,721	1,012
South Africa, Republic of	20,307	5,157	66	16	3,291	510	23,664	5,683
Swaziland	480	361	--	--	--	--	480	361
U.S.S.R	--	--	--	--	451	128	451	128
Total	22,718	6,576	26,839	10,438	716,607	106,808	766,164	123,822

[1] Less than ½ unit.

Table 9.—Canadian fiber sources corporately related to major U.S. asbestos products manufacturing firms[1]

U.S. asbestos products firms	Canadian mine sources	Fiber-producing capacity (short tons per year)
The Flintkote Co	Flintkote Mines, Ltd., Quebec	33,000
Asarco	Lake Asbestos of Quebec, Ltd	210,000
Johns-Manville Corp	Canadian Johns-Manville Co., Ltd	835,000
Jim Walter Corp	Carey-Canadian Mines, Ltd	200,000
Raybestos-Manhattan, Inc	Cassiar Asbestos Corp. Ltd (partial interest)	110,000
General Dynamics Corp	Asbestos Corp., Ltd. (54% interest)	500,000
Total		1,888,000

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[1] Extracted from Economic Analysis of Proposed Effluent Guidelines, The Asbestos Products Manufacturing Industry, EPA-230/1-73-001, September 1973.

WORLD REVIEW

Available information indicates that 1974 was another record year for asbestos in spite of a decline in Canadian production. Demand outstripped supply, as evidenced by a shortage throughout the year. Market growth was again limited by supply, but no real hardships surfaced, except that spinning-grade fibers were in very short supply all year. The market situation, labor problems, and worldwide inflation would indicate substantial price increases again in 1975.

An interesting comment on the world market was made by an industry publication.[3] "Directly or indirectly, the apparent consumption of asbestos is linked to comparative levels of industrialization. For instance, in the period from 1964 to 1970, North American asbestos consumption declined by 0.9% while, in the same period, demand from Western Europe grew by only 3.0%. In the developing countries, consumption rose substantially during those years: the Middle East 11.9%; Africa 16.0%; South America 9.5%; Pacific Basin countries 10.3%; and Eastern European countries and China, 18.3%."

Australia.—The Woodsreef mine was producing at a rate of about 50,000 tons per year even though Chrysotile Corp., the parent company, was in receivership.

Bolivia.—Development work on a chrysotile prospect was continuing. A truck road 87 miles long now joins the mine and the new experimental processing mill at Cochabamba.

Canada.—Even though Canadian production was 3% below the record high of 1973, it was still the second highest ever and Canada remained the world's primary producer of asbestos fiber. Significantly Quebec production was actually higher than in 1973; the drop in production came from other Provinces.

The possibility of labor problems in 1975 led to an analysis of some 1973 data released by the Bureau de la Statistique du Québec. The average production worker actually worked nearly enough hours for 52 forty-hour weeks, and was paid for even more. His annual wages were $9,516 at $4.06 per hour worked. In contrast, in 1910[4] an entire shift of 13 men in a mill had a labor cost of $24.50. Only one, the millwright, made more for the entire shift than the average worker made per hour in 1973.

With the aim of increasing manufacturing in the Province, the Minister of Resources of Quebec announced creation of a Provincial mineral marketing corporation to increase the quantity of mineral raw materials exported in a manufactured form. Asbestos was to be among the first minerals scrutinized by the corporation.

The complexities of the asbestos marketplace were described in a report[5] on one Quebec producer who offered his customers 420 grades of fiber in 1,320 different forms.

The fire that destroyed part of the King-Beaver mill of the Asbestos Corp. Ltd. on December 8 could result in the loss of 160,000 tons of fiber production in 1975, or about 30% of the corporation's total production.

United Asbestos Corp. Inc. has firm plans to bring its Midlothian mine into full production in mid-1975. This mine should add 100,000 tons per year to Canadian production.

Extensive milling and testing were still underway at the Chibougamau mine of McAdam Mining Corp., but at yearend no production decision had been announced. The Amos mine of the Abitibi Asbestos Mining Co. has scheduled production for 1978.

Cassiar Corp. announced the probable closure in 1977 of its Clinton Creek, Yukon, mine. This would mean a loss of 100,000 tons per year of production.

Colombia.—Eternit Colombiana has purchased the 70% interest of Nicolet Industries, Inc., in the Las Brisas asbestos project. The mine is now expected onstream in late 1976 and will produce a high proportion of grades 4 and 5.

Turkey.—Domestic funding is being raised to develop the rich asbestos deposits in Sivas Province.

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[3] Asbestos Producer (Quebec Asbestos Mining Association). June–July 1974.

[4] Cirkel, F. Chrysotile Asbestos—Its Occurrence, Exploitation, Milling, and Uses. 1910, pp. 151–152.

[5] Asbestos Producer (Quebec Asbestos Mining Association). June–July 1974.

U.S.S.R.—A midsummer Pravda article, while discussing the projected Baikal-Amur rail line which will parallel the trans-Siberian Railway from Central Siberia to the Pacific, discussed at length the natural resources in areas to be touched by the new railway. Among those discussed were large deposits of long-fibered asbestos discovered at Molodezhny. A mine and mill are planned at the site 15 miles south of the railway in the Burgat A.S.S.R.

Table 10.—Asbestos: World production, by country
(Short tons)

Country [1]	1972	1973	1974 [p]
North America:			
Canada (sales)	1,687,051	1,862,976	1,824,000
Mexico	--	17	6
United States (sold or used by producers)	131,663	150,036	112,533
Latin America:			
Argentina	1,001	683	[e] 660
Brazil	36,247	51,809	49,458
Europe:			
Bulgaria	1,653	[e] 1,700	[e] 1,700
Finland [2]	7,042	6,985	6,165
Italy	144,702	164,525	165,629
Portugal	[3] 9	[e] 140	198
U.S.S.R.[e]	1,345,000	1,411,000	1,500,000
Yugoslavia	12,170	10,352	13,500
Africa:			
Egypt, Arab Republic of	486	363	[e] 330
Mozambique	[r] 600	624	--
Rhodesia, Southern [e]	88,000	88,000	88,000
South Africa, Republic of	356,206	366,683	369,739
Swaziland	36,817	40,675	35,738
Asia:			
China, People's Republic of [e]	220,000	230,000	230,000
Cyprus	[r] 32,827	34,950	[e] 28,000
India	13,528	12,456	21,310
Japan	15,903	[e] [r] 15,000	[e] 11,000
Korea, Republic of	[r] 5,819	6,291	6,294
Taiwan	2,962	5,851	3,964
Turkey	5,428	5,201	[e] 5,500
Oceania:			
Australia	18,561	45,715	[e] 62,200
Total	[r] 4,163,675	4,512,032	4,535,924

[e] Estimate. [p] Preliminary. [r] Revised.

[1] In addition to the countries listed, Czechoslovakia, North Korea, and Romania also produce asbestos, but available information is inadequate to make reliable estimates of output levels.

[2] Includes asbestos flour.

[3] Gross weight.

TECHNOLOGY

The terms "asbestos," "fiber," and their composite "asbestos fiber" have been the subjects of much discussion and controversy between and among producers, users, and those interested in the health aspects of asbestos. There is some mineralogic support for several variations of the definitions. It was thought that a consensus definition, arrived at by the deliberations of a group representing all viewpoints, would have validity. Such a group, the Task Force Group on Naturally Occurring Inorganic Fibers of The American Society for Testing and Materials Committee E-34 (Toxic Substances) has proposed the following mineralogical definitions of terms relating to naturally occurring inorganic fibers to reconcile the varying viewpoints:

Asbestiform.—Mineral structured in the form of asbestos.

Asbestos.—Generic term for naturally occurring, inorganic hydrated silicates that when processed separate into flexible fibers made up of fibrils. Minerals defined as asbestos are the asbestiform varieties of the following: serpentine (chrysotile), riebeckite (crocidolite), cummingtonite (amosite), anthophyllite, tremolite, and actinolite.

Fiber.—For the purpose of this standard, fibrous particulate designates fibers, fiber fragments, and fiber agglomerates.

Fibril.—A single crystal in the form of a fiber.

Fibrous particulate.—For the purpose of this standard, fibrous particulate designates fibers, fiber fragments, and fiber agglomerates.

Naturally occurring inorganic fiber.—Form of mineral characterized by properties of flexibility and length-to-width ratio in the order of 100, composed of definite crystal unit cells oriented with respect to a specific axis.

Note 1.—The designated 100:1 aspect ratio is considered to represent a reasonable lower limit for naturally occurring inorganic fibers. Fibers of these dimensions can be broken into parts of fibers that may maintain their same surface properties and activities. Therefore, fiber fragments may have to be evaluated for atmospheric monitoring purposes. However, attempting to define a fiber by its aspect ratio alone is inadequate since it is obvious that particles of nonfibrous material do not become fibers as their aspect ratio increases through comminution.

A Bureau of Mines study to be published in 1975 compared differences between the costs of mining asbestos in the Yukon Territory, Canada, and the probable costs in nearby Alaska. The conclusion reached by the author was that 30% higher costs, due principally to labor costs, were indicated for the Alaska operation.

Late in 1973 the Materials Division of the Hitco Corp. announced a high-temperature silica fiber coated with chromium oxide.

Many substitutes for asbestos were announced in 1974. The "Saffil" alumina and zirconium dioxide fibers developed by Imperial Chemical Industries of the United Kingdom had attractive chemical and thermal properties and good filtration characteristics. Some equally attractive fibers were made by a group of Soviet scientists and others using molten basalt. A Canadian scientist[6] published the details on how to fiberize asbestos tailings to produce mineral wool.

It is significant that the proposed uses for these substitute fibers was for thermal insulation and in no case as a reinforcing agent, the most common use of asbestos, which, incidentally, was named the material having the highest ultimate tensile strength of those listed in an article for 1975 publication.[7]

Both Hooker Chemical Corp. and Diamond Shamrock Corp. announced a synthetic membrane to replace the conventional asbestos diaphragm cell in the chlor-alkali process. Commercial testing of both cell types was underway at yearend.

Union Carbide Corp. announced its new RG–600 form of asbestos which has been treated with a proprietary coupling agent that promotes better dispersion of the fiber in plastic matrices as well as increasing bonding strength between the two.

On August 15 the EPA administrator announced that the agency was conducting an investigation of the presence of asbestos in all areas of the environment and that a fiber-sampling program had been designed to study natural runoff from geologic deposits, mining and milling operations, other industrial sources, and public water supply intakes. He also announced that EPA was cooperating with several Health, Education, and Welfare organizations in launching a major animal-feeding study.

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[6] Winer, A. Mineral Wool Insulation From Asbestos Tailings. CIM Bulletin, December 1974, pp. 97–104.

[7] Materials Engineering. Comparison of Materials. V. 81, No. 2, February 1975, p. 43.

Barite

By Frank B. Fulkerson [1]

Domestic mine production of barite continued at a high level in 1974 and totaled 1.1 million tons, the same as output in 1973. Production increased 39% in Nevada, the leading barite-mining State, but output declined in Alaska, Arkansas, and Missouri. Imports of barite, mostly of crude ore, were up 6% in 1974. The domestic and imported barite was ground and used primarily as a weighting material in oil well and gas well drilling fluids. Sales of ground and crushed barite for all purposes increased 4% over those in 1973. Increased requirements for the mineral in well drilling more than offset decreased demand for other uses.

Table 1.—Salient barite and barium-chemical statistics
(Thousand short tons and thousand dollars)

	1970	1971	1972	1973	1974
United States:					
Barite (Primary):					
Sold or used by producers	854	825	906	1,104	1,106
Value	$12,800	$13,491	$14,883	$16,688	$16,822
Imports for consumption	706	484	624	716	729
Value	$6,314	$4,468	$5,648	$7,596	$8,680
Ground and crushed sold by producers	1,388	1,330	1,461	1,571	1,637
Value	$34,294	$34,020	$45,590	$54,473	$64,394
Barium chemicals sold by producers	105	83	66	62	56
Value	$16,961	$15,488	$13,869	$13,899	$15,751
World: Production	4,338	4,114	[r] 4,360	[r] 4,673	4,789

[r] **Revised.**

Table. 2.—Barite (primary) sold or used by producers in the United States, by State
(Thousand short tons and thousand dollars)

State	1973		1974	
	Quantity	Value	Quantity	Value
Alaska	W	W	20	400
California	11	152	4	W
Missouri	196	3,395	177	3,386
Nevada	549	4,691	761	8,115
Other States [1]	349	8,450	144	4,920
Total [2]	1,104	16,688	1,106	16,822

W Withheld to avoid disclosing individual company confidential data; included with "Other States."
[1] **Arkansas, Georgia, Idaho (1974), Illinois (1974), and Tennessee.**
[2] **Data may not add to totals shown because of independent rounding.**

DOMESTIC PRODUCTION

Producers sold or used 1,106,000 short tons of primary barite in 1974. The term "primary barite," as used in this chapter, is defined as the first marketable product, and includes crude barite, flotation concentrate, and other beneficiated material such as washer, jig, or magnetic-separation concentrates.

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[1] Industry economist, Division of Nonmetallic Minerals.

Barite was produced from 37 mines compared with 38 mines in 1973. There were 16 active mines in Nevada, 12 in Missouri, 2 each in Georgia and Tennessee, and 1 each in Alaska, Arkansas, California, Idaho, and Illinois. Nevada provided 69% of the quantity but only 48% of the value. Barite produced in Nevada had a relatively low value owing to transportation costs and distance to markets. The other principal barite-producing States were, in descending order of production, Missouri, Georgia, and Arkansas. The production decreases in Arkansas and Missouri were attributed to mine closures in 1973 owing to ore depletion and higher operating costs. Georgia output was about the same as that in 1973.

The leading producers of domestic barite for use in well drilling were (in alphabetical order) Baroid Div., NL Industries, Inc., with mines in Arkansas, Missouri, Nevada, and Tennessee; Dresser Minerals Div., Dresser Industries, Inc., with mines in Missouri and Nevada; and Minerals Div., Milchem, Inc., with mines in Missouri and Nevada.

Barite for chemical, glass, and filler uses was sold or used by Minerals, Pigments & Metals Div., Pfizer, Inc.; New Riverside Ochre Co.; Paga Mining Co.; De Lore Products, Industrial Chemicals Div., NL Industries, Inc.; and Industrial Chemical Div., FMC Corp.

Imported and domestic barite was ground at 11 plants located at the coastal cities of Lake Charles, Morgan City, and New Orleans, La.; and Brownsville, Corpus Christi, and Houston, Tex. Domestic barite was also ground at mills in Arkansas, California, Illinois, Missouri, Nevada, and Utah.

During the year, Milchem, Inc., completed the Argenta crushing, jigging, and grinding plant near Battle Mountain, Nev. Production at the new facility was expected to begin in 1975. In the same area, Dresser Minerals placed its new beneficiation plant at the Greystone mine in full operation. IMCO Services terminated production in April at its mine in East Northumberland Canyon, Nye County, Nev. Crude ore from a stockpile was being processed in a portable jigging plant 2 miles from the mine site that began operation in August. The concentrated ore was hauled by truck 150 miles to the end of a railroad branch line at Mina, Nev., for shipment to Houston, Tex. All Minerals Corp. shipped ore to Utah, California, and Texas from the same area of Nye County.

Dresser Minerals completed a new beneficiation plant near Blackwell, Mo.

CONSUMPTION AND USES

Nearly 87% of the ground and crushed barite sold in 1974 was used as a weighting material in oil well and gas well drilling fluids. This use increased 9%, owing to greater drilling activity. Barite used in manufacturing barium chemicals and as a filler in paints declined 5% and 8%, respectively. Other uses dropped nearly 33%. These other uses were as filler in rubber and plastics; flux, oxidizer, and decolorizer in glass manufacturing; and miscellaneous uses, including ballast for ships and unspecified industrial uses.

The statistics in table 3 are mainly for ground barite, but they also include the relatively small tonnage of crushed barite, which is used principally in the barium-chemical industry.

Barite is the principal raw material in the production of barium chemicals. The major producers of barium chemicals in 1974 were Chemical Products Corp., Cartersville, Ga.; Industrial Chemical Div., FMC Corp., Modesto, Calif.; Mallinckrodt Chemical Works, St. Louis, Mo.; and Chemical Div., Sherwin-Williams Co., Coffeyville, Kans. Sherwin-Williams also produced lithopone. By volume, barium carbonate is the most important barium chemical. It is used in the manufacture of television picture tubes, for scum control in brick and tile, in barium ferrite manufacture, and for many other purposes. Barium hydroxide is used in ceramic work, as an additive in oils and greases, and in the sugar refining process. Lithopone, produced by reacting a barium sulfide solution with zinc sulfate, is used as a white pigment.

Table 3.—Ground and crushed barite sold, by use[1]

Use[2]	1972 Quantity (short tons)	1972 Percent of total	1973 Quantity (short tons)	1973 Percent of total	1974 Quantity (short tons)	1974 Percent of total
Barium chemicals[3]	105,589	7	108,693	7	103,219	6
Filler or extender:						
Paint	46,342	3	52,404	3	48,219	3
Rubber	W	--	W	--	W	--
Other filler	W	--	W	--	W	--
Well drilling	1,183,340	80	1,326,451	83	1,440,046	87
Other uses	142,183	10	104,722	7	70,252	4
Total	1,477,454	100	1,592,270	100	1,661,736	100

W Withheld to avoid disclosing individual company confidential data; included with "Other uses."

[1] Includes imported barite.

[2] Uses reported by producers of ground and crushed barite, except for barium chemicals.

[3] Quantities reported by consumers.

Table 4.—Barium chemicals produced and sold by producers in the United States in 1974[1]

(Short tons)

Chemical	Plants	Produced	Sold by producers Quantity	Sold by producers Value
Barium carbonate	4	41,573	30,262	$6,211,468
Barium chloride	2	W	W	W
Barium hydroxide	2	W	W	W
Barium oxide	1	W	W	W
Black ash	1	W	W	W
Blanc fixe	1	W	W	W
Other barium chemicals	3	28,493	25,783	9,539,323
Total	[2] 5	70,066	56,045	15,750,791

W Withheld to avoid disclosing individual company confidential data; included with "Other barium chemicals."

[1] Only data reported by barium-chemical plants that consume barite are included.

[2] A plant producing more than 1 product is counted only once.

PRICES

Barite prices are negotiated between buyer and seller. Prices listed in trade publications serve as a general guide but do not necessarily reflect actual transactions. Price quotations reported in the Engineering and Mining Journal were unchanged in 1974 compared with December 1973 prices.

The average selling value per ton, excluding container cost of ground and crushed barite, increased from $34.67 in 1973 to $39.34 in 1974. These values were calculated from statements by producers.

Table 5.—Barite price quotations in 1974

Item	Price per short ton
Chemical, filler, glass grades, f.o.b. shipping point, carload lots:	
Hand picked, 95% $BaSO_4$, not over 1% Fe	$29.50–$31.80
Magnetic or flotation, 96% $BaSO_4$, not over 0.5% Fe	34.50
Water ground, 99.5% $BaSO_4$, 325 mesh, 50-lb bags	60.00– 80.00
Drilling-mud grade:	
Ground, 83%–93% $BaSO_4$, 3%–12% Fe, specific gravity 4.20–4.30, f.o.b. shipping point, carload lots	40.00– 47.00
Crude, imported, specific gravity 4.20–4.30, c.i.f. gulf ports	17.00– 21.00

Source: Engineering and Mining Journal. V. 175, No. 12, December 1974.

FOREIGN TRADE

Barite exports declined 10%. Canada provided the principal market for these exports, mainly ground material, which were shipped through the following customs districts: New Orleans, 60%; Detroit, 24%; Houston, 6%; Seattle, 4%; Other, 6%.

Barite imports, comprised of 729,000

tons of crude material and 36,000 tons of ground barite, were up 6% over those of 1973. The principal sources were Peru and Ireland, followed by Mexico and Greece. Declared values per ton of crude barite at foreign ports averaged as follows for these countries: Peru, $9.95; Ireland, $11.72; Mexico, $12.06; and Greece, $14.09. Crude barite, nearly all of drilling-mud grade, entered the United States through the following customs districts: New Orleans, 44%; Laredo, 22%; Port Arthur, 20%; and Houston, Galveston, and El Paso, 14%. Ground barite was imported from Mexico.

Foreign trade statistics also showed imports of witherite, mainly from the United Kingdom. However, these statistics are open to question because there has been no reported production of witherite since the Settlingstones mine in northern England was closed in 1969. These imports could be manufactured barium carbonate instead of natural barium carbonate (witherite).

Imports of blanc fixe (precipitated barium sulfate), barium chloride, and barium hydroxide increased significantly over those of 1973. The Federal Republic of Germany, France, Italy, and the U.S.S.R. were the major sources of these imports.

Table 6.—U.S. exports of natural barium sulfate and carbonate

Country	1973		1974	
	Quantity (short tons)	Value (thousands)	Quantity (short tons)	Value (thousands)
Angola	--	--	4,389	$264
Argentina	59	$2	80	9
Australia	--	--	116	6
Barbados	283	26	--	--
Brazil	400	14	416	28
Cameroon	--	--	1,202	129
Canada	38,800	1,579	41,539	1,242
Colombia	230	10	80	3
Costa Rica	43	2	--	--
El Salvador	47	5	--	--
Ethiopia	2,174	93	--	--
France	196	7	--	--
Ghana	--	--	1,058	82
Guatemala	269	11	60	3
Honduras	75	4	--	--
Indonesia	38	1	--	
Israel	18	1	753	42
Japan	71	3	44	3
Leeward and Windward Islands	26	1	--	--
Malagasy Republic	--	--	420	29
Mexico	378	17	263	14
Netherlands	235	8	--	--
New Guinea	1,878	95	--	--
New Zealand	--	--	350	30
Nicaragua	--	--	4,492	310
Niger	--	--	40	2
Pakistan	--	--	1,804	79
Peru	20	1	86	4
Philippines	363	17	1,310	74
Saudi Arabia	1,145	68	2,030	126
Senegal	648	27	--	--
Singapore	19,442	835	--	--
South Africa, Republic of	317	13	512	26
Taiwan	525	28	--	--
United Arab Emirates	178	8	--	--
Venezuela	228	8	201	13
Total	68,086	2,884	61,245	2,518

Table 7.—U.S. imports for consumption of barite, by country

(Thousand short tons and thousand dollars)

Country	1973		1974	
	Quantity	Value	Quantity	Value
Crude barite:				
Belgium-Luxembourg	--	--	(1)	1
Canada	50	567	34	389
Guatemala	(1)	2	--	--
Greece	51	691	64	902
Ireland	227	2,524	230	2,696
Mexico	142	1,577	127	1,531
Morocco	42	706	41	842
Peru	201	1,493	233	2,319
Turkey	3	36	--	--
Total	716	7,596	729	8,680
Ground barite:				
Canada	(1)	16	(1)	4
Germany, West	--	--	(1)	17
Mexico	9	155	36	454
Total	9	171	36	475

[1] Less than ½ unit.

Table 8.—U.S. imports for consumption of barium chemicals

Year	Lithopone		Blanc fixe (precipitated barium sulfate)		Barium chloride		Barium hydroxide	
	Quantity (short tons)	Value (thousands)	Quantity (short tons)	Value (thousands)	Quantity (short tons)	Value (thousands)	Quantity (short tons)	Value (thousands)
1972	84	$17	6,412	$1,691	7,316	$938	63	$12
1973	84	29	7,522	1,631	10,774	1,987	2,481	800
1974	262	139	8,843	2,273	13,455	3,545	10,072	4,173

Year	Barium nitrate		Barium carbonate precipitated		Other barium compounds	
	Quantity (short tons)	Value (thousands)	Quantity (short tons)	Value (thousands)	Quantity (short tons)	Value (thousands)
1972	685	$126	8,316	$841	716	$334
1973	691	138	10,206	1,603	1,022	531
1974	455	151	8,719	1,728	1,577	1,029

Table 9.—U.S. imports for consumption of crude, unground, and crushed or ground witherite

Year	Crude, unground		Crushed or ground	
	Quantity (short tons)	Value (thousands)	Quantity (short tons)	Value (thousands)
1972	--	--	1,311	$169
1973	141	$19	4,470	697
1974	8	1	3,432	709

WORLD REVIEW

World barite production continued at a high level in 1974. According to preliminary estimates, the United States supplied 23% of the world total.

Canada.—Nuspar Resources, Ltd., was investigating a bedded-type barite deposit discovered 130 miles northeast of Ross River in the eastern Yukon. A feasibility study, including drilling, was to be conducted in 1975.[3]

Norway.—Plans were disclosed for constructing a large barite-grinding mill at Dalen. Participants in the venture were A/S Norcem of Oslo, a cement manufacturing company, and British Ceca Co., Ltd., a chemical and drilling-mud concern. Barite was to be delivered in bulk to drilling platforms in the North Sea. The plant was to be onstream by the end of 1974.[3]

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[3] Northern Miner (Toronto). V. 60, No. 38, Dec. 5, 1974. p. 6.

Pakistan.—Pakistan Petroleum, Ltd., and the Government of Baluchistan Province began a joint venture for mining and processing barite from a deposit near the village of Khuzdar in the Central Makran Mountain Range. The deposit is estimated to contain over 1.3 million tons of ore. It was expected that the bulk of the output would be exported. This new project should significantly increase Pakistan's barite production, which has averaged less than 5,000 tons in recent years.

Philippines.—Falcon Industrial Minerals Co. planned to establish a 1,000-ton-per-month barite mill at Mansalay, Mindoro. Production of drilling-mud-grade barite was expected to begin by yearend.[4]

Turkey.—Turkey has barred the export of crude barite. Only ground barite can now be exported.[5]

United Kingdom.—The Highlands and Islands Development Board released a report by a firm of mineral consultants on barite deposits in the Scottish highlands and islands. The consultants advised the board that areas of Sunart and Morven in northern Argyle contain barite occurrences offering best prospects for development.[6]

The port cities of Aberdeen and Dundee have become supply centers for the vessels that serve the specialized needs of oil rigs drilling at ocean depths of 500 feet and more in the North Sea. Two fully integrated supply bases have been completed at Aberdeen at which a supply vessel can dock and be simultaneously loaded with drilling mud, cement, pipe, water, and fuel for rig operations. Four other such bases are under construction at Aberdeen.[7]

TECHNOLOGY

A patent was issued on the froth flotation of barite, celestite, or similar minerals. The ore pulp was conditioned with a depressant for gangue minerals, and with a tetrasodium sulfosuccinamate compound as the collector for the values. The conditioned pulp was then subjected to flotation to concentrate the values in the froth.[8]

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[3] Industrial Minerals (London). Another New North Sea Barytes Plant. No. 83, August 1974, p. 24.

[4] Mining Journal. Philippine Barite Mill. V. 282, No. 7237, May 3, 1974, p. 355.

[5] Industrial Minerals (London). No. 87, December 1974, p. 56.

[6] Industrial Minerals (London). Scottish Barytes Report. No. 82, July 1974, p. 36.

[7] Midderson, R. New Energy From the North Sea. Port of Houston Mag. V. 18, No. 9, September 1974, pp. 9–12.

[8] Day, A., and H. Hartjens (assigned to American Cynamid Co.). U.S. Pat. 3,830,366, Aug. 20, 1974.

Table 10.—Barite: World production, by country

(Thousand short tons)

Country [1]	1972	1973	1974 [p]
North America:			
Canada	77	102	[e] 125
Mexico	288	281	[e] 275
United States [2]	906	1,104	1,106
South America:			
Argentina	26	32	[e] 33
Brazil	97	80	59
Chile	7	5	5
Colombia	7	2	[e] 2
Peru	218	[e] 240	[e] 240
Europe:			
Austria	(3)	(3)	(3)
Czechoslovakia [e]	8	8	8
France	110	[e] 110	[e] 110
Germany, East [e]	33	34	34
Germany, West	406	360	329
Greece [4]	97	87	94
Ireland	257	[e] 275	[e] 275
Italy	197	183	[e] 196
Poland [e]	55	55	60
Portugal	1	1	1
Romania [e]	128	128	128
Spain	[r] 99	104	[e] 110
U.S.S.R.[e]	342	356	360
United Kingdom [e]	24	25	30
Yugoslavia	78	68	72
Africa:			
Algeria [5]	39	[e] [r] 45	[e] 44
Egypt, Arab Republic of	2	2	2
Kenya	1	1	[e] 1
Morocco	103	113	103
South Africa, Republic of	3	2	2
Swaziland	(3)	(3)	(3)
Tunisia	1	20	19
Asia:			
Afghanistan	--	[e] 5	[e] 10
Burma	29	17	[6] 17
China, People's Republic of [e]	171	182	200
India	51	129	[e] 130
Iran [7]	88	105	[e] 125
Japan	[r] 72	69	42
Korea, North [e]	132	132	132
Korea, Republic of	(3)	(3)	(3)
Pakistan	3	2	2
Philippines	--	4	[e] 4
Thailand	107	123	221
Turkey	78	71	[e] 72
Oceania: Australia	29	11	[e] 11
Total	[r] 4,360	4,673	4,789

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[e] Estimate. [p] Preliminary. [r] Revised.

[1] In addition to the countries listed, Bulgaria and Southern Rhodesia also produce barite, but available information is inadequate to make reliable estimates of output levels.

[2] Sold or used by producers.

[3] Less than ½ unit.

[4] Barite concentrates.

[5] Ground barite.

[6] Year beginning Apr. 1, 1974.

[7] Year beginning March 21 of that stated.

Bauxite

By Horace F. Kurtz[1]

The formation of the International Bauxite Association, an organization of bauxite-producing countries, and the imposition of greatly increased taxes on bauxite production by most of the countries supplying the United States were among the most significant events in the bauxite industry in 1974.

World bauxite production increased 12% to about 77 million long tons. The strong growth rate was the highest in 5 years and largely reflected increased demand for aluminum, the principal end use of bauxite. World alumina production, the intermediate step between bauxite and aluminum production, rose 9% to nearly 32 million short tons.

Bauxite and alumina production in the United States increased 4% and 3%, respectively. Imports provided over 30% of the new supply of alumina and nearly 90% of the bauxite used by domestic alumina producers.

Legislation and Government Programs.—Jamaica-type metallurgical-grade bauxite in government stockpiles was authorized for sale during 1974, but none was sold. Surinam-type metallurgical-grade bauxite sold previously was shipped from government stockpiles.

Table 1.—Salient bauxite statistics

(Thousand long tons and thousand dollars)

	1970	1971	1972	1973	1974
United States:					
Production, crude ore (dry equivalent)	2,082	1,988	1,812	1,879	1,949
Value	30,070	28,543	23,238	26,635	25,663
Exports (as shipped)	3	34	29	12	16
Imports for consumption[1]	[r] 12,833	[r] 12,634	[r] 11,976	[r] 12,778	14,308
Consumption (dry equivalent)	15,673	15,619	15,375	[r] 16,650	16,904
World: Production	56,873	61,143	[r] 63,921	[r] 68,821	76,989

[r] Revised.

[1] Excludes calcined bauxite and bauxite imported into the Virgin Islands.

DOMESTIC PRODUCTION

The production of bauxite increased 4% to 1.95 million long tons (dry equivalent) in 1974. Arkansas produced 89% of the total. The remainder was mined in Alabama and Georgia. All of the bauxite mines were open pit operations except the Mars Hill underground mine of Reynolds Mining Corp. in Saline County, Ark.

In Arkansas, bauxite was mined by Aluminum Co. of America (Alcoa), American Cyanamid Co., and Reynolds in Saline County and by Stauffer Chemical Co. in Pulaski County. Bauxite processing plants were operated by American Cyanamid, Porocel Corp., and Stauffer.

In Alabama, bauxite was mined in the Eufaula district of Barbour and Henry Counties by Abbeville Lime Co., A. P. Green Refractories Co., Harbison-Walker Refractories, and Wilson-Snead Mining Co. The Eufaula Bauxite Mining Co., which produced in 1973, was acquired by Harbison-Walker. Drying or calcining plants were operated by A. P. Green, Harbison-Walker, and Wilson-Snead.

C–E Minerals and American Cyanamid mined bauxite in Sumter County, Ga., and operated treatment plants at Andersonville, Ga.

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[1] Industry economist, Division of Nonferrous Metals.

Production of alumina and aluminum oxide products (excluding aluminates) at the eight alumina plants in the United States and the one plant in the U.S. Virgin Islands increased 3% to 7,812,000 short tons (7,589,000 tons calcined alumina equivalent) in 1974. The total production included 7,059,000 tons of calcined alumina, 635,000 tons of commercial alumina trihydrate, and 118,000 tons of tabular, activated, and other alumina. The output of each type of alumina except hydrate increased. Production of hydrate, which more than doubled between 1967 and 1972, declined slightly in 1973, and remained at that level in 1974.

Alumina shipments by producers totaled 7,796,000 tons (7,575,000 tons calcined equivalent) and were valued at $714 million. Calcined alumina shipments to primary aluminum plants totaled 6,766,000 tons, or 89% of the calcined equivalent of total shipments. The chemical industry, including producers of aluminum fluoride fluxes for aluminum plants, received over half of the remaining tonnage, largely as hydrate. Other shipments of alumina went mainly to producers of abrasives, ceramics, and refractories.

Table 2.—Mine production of bauxite and shipments from mines and processing plants to consumers in the United States

(Thousand long tons and thousand dollars)

State and year	Mine production			Shipments from mines and processing plants to consumers		
	Crude	Dry equivalent	Value [1]	As shipped	Dry equivalent	Value [1]
Alabama and Georgia:						
1970 [2]	270	213	3,778	149	161	3,299
1971	261	207	3,564	143	171	3,566
1972	227	178	2,228	187	218	4,605
1973	247	193	2,751	221	265	5,782
1974	272	218	2,066	221	264	6,607
Arkansas:						
1970	2,251	1,869	26,298	2,194	1,917	29,049
1971	2,157	1,781	24,979	2,161	1,892	28,296
1972	1,973	1,634	21,010	2,128	1,844	25,426
1973	2,040	1,686	23,884	2,079	1,782	27,180
1974	2,098	1,731	23,597	2,130	1,811	26,841
Total United States: [3]						
1970 [2]	2,522	2,082	30,070	2,343	2,078	32,348
1971	2,419	1,988	28,543	2,305	2,063	31,862
1972	2,200	1,812	23,238	2,314	2,061	30,032
1973	2,287	1,879	26,635	2,300	2,047	32,962
1974	2,370	1,949	25,663	2,351	2,075	33,448

[1] Computed from selling prices and values assigned by producers and from estimates of the Bureau of Mines.
[2] Includes data for Oregon and Washington.
[3] Data may not add to totals shown because of independent rounding.

Table 3.—Recovery of dried, calcined, and activated bauxite in the United States

(Thousand long tons)

Year	Crude ore treated	Total processed bauxite recovered [1]	
		As recovered	Dry equivalent
1970	428	259	343
1971	444	250	357
1972	399	210	319
1973	338	169	287
1974	348	177	279

[1] Dried, calcined, and activated bauxite.

Table 4.—Percent of domestic bauxite shipments by silica content

SiO_2 (Percent)	1970	1971	1972	1973	1974
Less than 8	19	4	6	6	2
From 8 to 15	54	65	64	61	72
More than 15	27	31	30	33	26

Table 5.—Production and shipments of alumina in the United States

(Thousand short tons)

Year	Calcined alumina	Other alumina [1]	Total	
			As produced or shipped [2]	Calcined equivalent
Production: [3]				
1970	6,670	478	7,148	7,001
1971	6,545	668	7,218	7,002
1972	6,235	741	6,976	6,789
1973	6,834	734	7,568	7,344
1974	7,059	753	7,812	7,589
Shipments:				
1970	6,631	476	7,106	6,961
1971	6,525	659	7,184	6,975
1972	6,222	745	6,968	6,730
1973	6,822	738	7,561	7,335
1974	7,051	745	7,796	7,575

[1] Trihydrate, activated, tabluar, and other aluminas. Excludes calcium and sodium aluminates.
[2] Data may not add to totals shown because of independent rounding.
[3] Includes only the end product if one type of alumina was produced and used to make another type of alumina.

Table 6.—Capacities of domestic alumina plants, December 31, 1974[1]

(Thousand short tons per year)

Company and plant	Capacity
Aluminum Co. of America:	
Bauxite, Ark	[e] 375
Mobile, Ala	[e] 1,025
Point Comfort, Tex	[e] 1,350
Total	2,750
Martin Marietta Aluminum, Inc.: St. Croix, V.I	370
Kaiser Aluminum & Chemical Corp.:	
Baton Rouge, La	1,025
Gramercy, La	800
Total	1,825
Ormet Corp.: Burnside, La	600
Reynolds Metals Co.:	
Hurricane Creek, Ark	840
Corpus Christi, Tex	1,385
Total	2,225
Grand total	7,770

[e] Estimate by the Bureau of Mines.
[1] Capacity may vary depending upon the bauxite used.

CONSUMPTION AND USES

The consumption of bauxite in the United States (including the Virgin Islands) increased 1.5% to 16.9 million long tons (dry basis). Foreign sources provided 88% of the total bauxite consumed during the year. Usage increased in each of the major consuming industries.

The production of alumina and related products required 93% of the total bauxite consumed. An average of 2.06 long dry tons of bauxite was used to produce 1 short ton (calcined basis) of alumina. The two alumina plants in Arkansas used mainly bauxite mined in Arkansas, and the other seven alumina plants used only imported ore.

The refractories industry used over one-half million tons (dry weight basis) of bauxite, establishing another record high level. Nearly all of this bauxite was used in the calcined form, which weighs about 65% of the dry equivalent weight. Imports comprised 83% of the bauxite used in refractories. Refractory producers reported that 84% of their receipts of foreign bauxite came from Guyana and 12% from Surinam.

Five companies consumed bauxite in manufacturing artificial abrasives, and all of the bauxite used was imported calcined ore. About 85% of the bauxite imported by these companies during the year came from Surinam, and the remainder came from the People's Republic of China. Data on consumption by the abrasives industry included bauxite fused and crushed in Canada because much of this material is made into abrasive wheels and coated products in the United States. About 10% to 15% of this material is used for nonabrasive applications, principally refractories.

Consumption of bauxite by the chemicals industry increased 9%. The United States, Guyana, and Surinam were the bauxite sources for this industry. Other consumers of bauxite, in descending order of magnitude, included the cement, oil and gas, and steel and ferroalloys industries, and municipal waterworks.

Thirty-one primary aluminum plants in the United States consumed 9,384,000 short tons of calcined alumina, compared with 8,729,000 tons in 1973. Alumina consumption data for other uses were not available. A significant quantity was used to make aluminum fluoride and synthetic cryolite, which is also used in the production of primary aluminum.

Table 7.—Bauxite consumed in the United States by industry

(Thousand long tons, dry equivalent)

Year and industry	Domestic	Foreign	Total [1]
1973:			
Alumina	1,725	13,784	15,509
Abrasive [2]	--	259	259
Chemical	[3] 167	r [3] 219	313
Refractory	81	414	496
Other	W	W	r 78
Total [1] [2]	1,974	r 14,676	r 16,650
1974:			
Alumina	1,720	13,924	15,644
Abrasive [2]	--	295	295
Chemical	[3] 175	[3] 250	341
Refractory	93	446	539
Other	W	W	85
Total [1] [2]	1,989	14,915	16,904

r Revised. W Withheld to avoid disclosing individual company confidential data; included with "Chemical."

[1] Data may not add to totals shown because of independent rounding.

[2] Includes consumption by Canadian abrasive industry. Small quantity of domestic bauxite included with foreign in 1973.

[3] Includes other uses.

Table 8.—Crude and processed bauxite consumed in the United States

(Thousand long tons, dry equivalent)

Type	Domestic origin	Foreign origin	Total [1]
1973:			
Crude and dried	1,743	r 14,008	r 15,751
Calcined and activated	226	673	899
Total	1,974	r 14,676	r 16,650
1974:			
Crude and dried	1,743	14,172	15,914
Calcined and activated	246	743	989
Total [1]	1,989	14,915	16,904

r Revised.

[1] Data may not add to totals shown because of independent rounding.

Table 9.—Production and shipments of selected aluminum salts in the United States in 1973

(Thousand short tons and thousand dollars)

Item	Number of producing plants	Production	Total shipments including interplant transfers	
			Quantity	Value
Aluminum sulfate:				
Commercial (17% Al_2O_3)	68	1,252	1,195	55,284
Municipal (17% Al_2O_3)	3	6	XX	XX
Iron-free (17% Al_2O_3)	21	230	214	6,383
Aluminum chloride:				
Liquid (32°Bé)	5	NA	NA	NA
Crystal (32°Bé)				
Anhydrous (100% $AlCl_3$)	5	37	35	10,946
Aluminum fluoride, technical	6	140	140	36,999
Aluminum hydroxide, trihydrate (100% $Al_2O_3 \cdot 3H_2O$)	7	607	568	49,070
Other inorganic aluminum compounds [1]	XX	XX	XX	24,587

NA Not available. XX Not applicable.

[1] Includes sodium aluminate, light aluminum hydroxide, cryolite, and alums.

Source: Data are based upon Bureau of the Census report Form MA-28E.1, Annual Report on Shipments and Production of Inorganic Chemicals.

STOCKS

Stocks of bauxite in the United States increased about 2% to 19.7 million long dry tons. The increase was attributed largely to a 700,000-ton addition to inventories of imported bauxite at alumina plants. Government stockpiles were reduced by 206,000 tons, all of which was Surinam-type bauxite shipped from defense inventories. A Government stockpile accumulated during World War II and purchased by Reynolds Metals Co. was removed from Government stockpile records and was included with data on consumers' stocks.

At the end of 1974, the Government stockpile comprised 4,638,000 tons of Jamaica-type bauxite, which was the total stockpile objective, 9,789,000 tons of Jamaica-type, Surinam-type, and refractory-grade bauxite classified as uncommitted excess (unsold), and 725,000 tons committed for sale.

Inventories of alumina and related products at plants producing alumina and primary aluminum increased 11% to 1,355,000 short tons. The Government held no stocks of alumina except in the form of abrasive grain and crude fused aluminum oxide. These stockpiles were reduced 8% to 357,000 short tons.

Table 10.—Stocks of bauxite in the United States [1]

(Thousand long tons, dry equivalent)

Sector	Dec. 31, 1973 r	Dec. 31, 1974
Producers and processors	624	550
Consumers [2]	3,244	3,990
Government	15,358	15,152
Total	19,226	19,692

r Revised.

[1] Domestic and foreign bauxite; crude, dried, calcined, activated; all grades.

[2] Includes bauxite stockpiled during World War II and purchased by Reynolds Metals Co.

Table 11.—Stocks of alumina in the United States [1]

(Thousand short tons)

Sector	Dec. 31, 1973	Dec. 31, 1974
Producers	214	230
Primary aluminum plants	r 1,011	1,125
Total	r 1,225	1,355

r Revised.

[1] Excludes consumers stocks other than those at primary aluminum plants.

PRICES

Prices on most of the bauxite and alumina produced throughout the world are not quoted because the large tonnages used by the aluminum industry are usually obtained from affiliated companies or purchased under long-term negotiated contracts.

Bureau of Mines estimates of the value of domestic production were based on data supplied by producers. The Bureau's estimated average value of crude domestic bauxite shipments in 1974, f.o.b. mine or plant, was $11.01 per long ton. The average value of shipments of domestic calcined bauxite was estimated at $50.32 per ton, compared with $41.78 in 1973. Bauxite values among producers varied widely because of differences in grade.

The average value of imported dried or partially dried bauxite consumed at alumina plants in the United States and the Virgin Islands in 1974 was estimated at $23.21 per long dry ton, compared with $14.84 in 1973. Engineering and Mining Journal published the following prices on supercalcined refractory-grade bauxite imported from Guyana, car lots, per long ton:

	January–August	September–December
F.o.b. Baltimore, Md	$62.50	$87.90
F.o.b. Mobile, Ala	62.53	88.01

The average value of domestic calcined alumina shipments as determined from producers' reports was $88.59 per short ton. Shipments of alumina trihydrate averaged $84.52 per ton. The average value of imported alumina (including small quantities of hydrate), as reported by the Bureau of the Census, was $74.61 per ton at port of shipment. Exports of alumina from the United States and the Virgin Islands averaged $106.15 per ton.

Table 12.—Market quotations on alumina and aluminum compounds

(In bags, carlots, freight equalized)

Compounds	Jan. 1, 1974	Dec. 31, 1974
Alumina, calcined ---- per pound --	$0.06	$0.063–$0.069
Alumina, hydrated, heavy ---- do ----	$0.0445–.0455	.0553
Alumina, activated, granular, works ---- do ----	.1365	.1365
Aluminum sulfate, commercial, ground (17% Al_2O_3) - per ton --	67.25	72.25–93.00
Aluminum sulfate, iron-free dry (17% Al_2O_3) ---- do ----	98.60	115.60

Source: Chemical Marketing Reporter.

FOREIGN TRADE

Exports from the United States classified as "bauxite and concentrates of aluminum excluding alumina" totaled 16,000 long tons in 1974 and were valued at $1.2 million. Canada received 80% of the total.

Exports of alumina, including 28,000 short tons of aluminum hydroxide, declined for the fourth successive year, to 738,000 tons. Most of the exports were shipped from domestic alumina plants to affiliated aluminum plants in Canada, Ghana, Mexico, and Venezuela. An additional 219,000 tons was exported from the alumina plant in the U.S. Virgin Islands to Norway and the U.S.S.R.

Aluminum sulfate exports doubled in 1974, rising to 42,000 short tons, valued at $1.8 million. Venezuela received 26,000 tons, and Canada received 7,000 tons. Exports of artificial corundum or fused aluminum oxide increased slightly to 32,000 tons, valued at $14.9 million. Canada, which received 10,000 tons, and the United Kingdom, which received 7,000 tons, were the leading recipients. Exports classified as "other aluminum compounds" increased to 46,000 tons and were valued at $16.8 million. Much of the tonnage was believed to be aluminum fluoride and synthetic cryolite shipped to other countries for use as a flux in making primary aluminum. Canada received 10,000 tons, Surinam 8,000 tons, Ghana 6,000 tons, and Bahrain 5,000 tons.

Table 13.—U.S. exports of alumina,[1] by country

(Thousand short tons and thousand dollars)

Country	1972		1973		1974	
	Quantity	Value	Quantity	Value	Quantity	Value
Australia	(2)	151	1	288	5	1,098
Canada	282	21,119	328	25,299	266	25,336
France	2	475	2	627	2	672
Germany, West	2	1,388	11	1,518	5	2,103
Ghana	106	5,652	133	8,749	241	15,542
Hungary	44	2,594	--	--	--	--
Italy	3	565	3	754	4	1,147
Japan	3	4,022	6	6,910	8	5,931
Mexico	109	7,572	101	7,442	128	11,121
Poland	43	3,182	20	1,180	(2)	18
Sweden	19	1,351	66	3,892	6	888
U.S.S.R	237	12,835	48	2,800	1	473
United Kingdom	2	628	4	1,878	5	1,998
Venezuela	20	1,577	33	2,633	54	5,082
Yugoslavia	--	--	3	735	(2)	16
Other	7	2,601	6	2,378	13	5,900
Total	879	65,702	765	67,078	738	77,325

[1] Includes exports of aluminum hydroxide: 1972—41,000 short tons; 1973—26,000 tons; 1974—28,000 tons.

[2] Less than ½ unit.

NOTE.—Excludes alumina exported from the Virgin Islands to foreign countries: 1972—Cyprus 26,000 tons, Norway 191,000 tons, Poland 58,000 tons; 1973—Norway 157,000 tons, the U.S.S.R. 126,000 tons; 1974—Norway 177,000 tons, the U.S.S.R. 42,000 tons.

No duties were imposed on imports of bauxite, alumina, or aluminum hydroxide in 1974. All duties on these commodities were suspended in 1971.

Imports of crude, partially dried, and dried bauxite increased 12% to 14.3 million long tons from 12.8 million tons (revised) in 1973. Jamaica provided 54% of the total, Surinam provided 20%, and the Dominican Republic provided 9%. Although imports from these three countries, traditionally the leading sources of metallurgical-grade bauxite, increased during 1974, receipts from the Boké project in Guinea provided the largest increase. An additional 761,000 tons of bauxite was imported into the U.S. Virgin Islands, largely from Guinea.

Calcined bauxite imports into the United States increased to 304,000 long calcined tons. Most of this tonnage was refractory-grade bauxite from Guyana. Additional calcined bauxite was imported into Canada for manufacture into crude fused aluminum oxide, much of which was subsequently used in abrasive and refractory products in the United States.

Alumina imports, including small quantities of aluminum hydroxide, rose 6% to a record 3.6 million short tons. Shipments from Australia provided 61% of the total and most of the increase. The remainder came largely from Jamaica, 25%, and Surinam, 13%. An additional 83,000 tons of alumina was shipped from the U.S. Virgin Islands to aluminum plants in Oregon and Washington.

Table 14.—U.S. imports for consumption of bauxite, crude and dried by country
(Thousand long tons)

Country	1972	1973	1974
Australia	277	359	--
Dominican Republic[1]	[r] 1,023	[r] 1,101	1,283
Greece	3	45	--
Guinea	8	[r] 164	1,256
Guyana	360	483	606
Haiti[2]	[r] 707	[r] 696	586
Jamaica[2]	[r] 7,049	[r] 7,273	7,766
Sierra Leone	15	--	--
Surinam	2,534	2,651	2,811
Other	([3])	6	--
Total	[r] 11,976	[r] 12,778	14,308

[r] Revised.
[1] Dry equivalent weight.
[2] Dry equivalent of shipments to the United States.
[3] Less than ½ unit.

NOTE.—Excludes bauxite imported into Virgin Islands from foreign countries: 1972—Australia 220,000 tons, Guinea 57,000 tons, Guyana 347,000 tons; 1973—Australia 162,000 tons, Guyana 463,000 tons; 1974—Australia 73,000 tons, Guinea 414,000 tons, Guyana 143,000 tons, Sierra Leone 23,000 tons, Surinam 96,000 tons, other countries, 12,000 tons.

Table 15.—U.S. imports of bauxite for consumption from Dominican Republic and Haiti
(Thousand long tons, dry equivalent)

Year[r]	Dominican Republic	Haiti[1]
1963	729	375
1964	778	430
1965	942	382
1966	793	354
1967	1,001	362
1968	951	435
1969	1,115	663
1970	1,106	634
1971	1,096	626
1972	1,023	707
1973	1,101	696
1974	1,283	586

[r] Revised.
[1] Shipments to the United States.

Table 16.—U.S. imports for consumption of bauxite (calcined) by country
(Thousand long tons and thousand dollars)

Country	1972		1973		1974	
	Quantity	Value	Quantity	Value	Quantity	Value
Australia	6	223	--	--	--	--
Canada	(1)	6	6	397	(1)	18
Guyana	185	9,342	247	13,300	252	17,433
Surinam	35	1,652	36	1,843	50	2,153
Trinidad and Tobago	21	1,139	--	--	--	--
Other	--	--	5	211	2	128
Total	247	12,362	294	15,751	304	19,732

[1] Less than ½ unit.

Table 17.—U.S. imports for consumption of alumina[1] by country
(Thousand short tons and thousand dollars)

Country	1972		1973		1974	
	Quantity	Value	Quantity	Value	Quantity	Value
Australia	1,168	67,674	r 1,970	r 118,529	2,202	154,376
Canada	20	2,136	21	2,489	20	2,322
Finland	--	--	(2)	8	4	1,798
France	23	1,936	1	924	9	9,554
Germany, West	1	483	3	1,075	6	2,605
Greece	107	6,138	--	--	--	--
Guinea	5	357	r 22	1,294	--	--
Guyana	58	3,584	33	1,936	10	609
Jamaica	748	48,836	904	57,768	902	69,241
Japan	138	8,599	73	5,077	(2)	55
Surinam	571	32,916	380	22,008	473	29,489
Other	11	854	(2)	r 180	1	568
Total	2,850	173,413	r 3,407	r 211,288	3,627	270,617

r Revised.
[1] Includes small quantities of aluminum hydroxide.
[2] Less than ½ unit.

NOTE.—Shipments from the Virgin Islands to the United States: 1972—67,051 short tons ($4,827,674); 1973—23,424 short tons ($1,686,505); 1974—33,079 short tons ($9,210,133).

WORLD REVIEW

Representatives of the Governments of Australia, Guinea, Guyana, Jamaica, Sierra Leone, Surinam, and Yugoslavia met in Guinea in March 1974 and agreed to establish the International Bauxite Association (IBA). The announced objectives of IBA included the securing of fair and equitable returns from the exploitation of bauxite resources in member countries and the securing of effective national control over their bauxite industries. Headquarters of IBA was established in Kingston, Jamaica.

The first regular meeting of IBA was held in Guyana in November. The meeting reportedly was primarily concerned with administrative business, although other matters such as bauxite and alumina pricing and taxation were discussed. The Dominican Republic, Ghana, and Haiti were admitted as new members of IBA. The 10 countries comprising IBA produced 74% of the world's bauxite in 1974 and had an estimated two-thirds of the world bauxite reserves.

World production of bauxite increased 12% in 1974. The greatest increase occurred in Guinea, and additional large increases were expected in Guinea during the second half of the decade. The rest of the increase in world production in 1974 was largely attributed to increases in the two largest producers, Australia and Jamaica, which together produced about 45% of the world total. Major output declines were in France, Malaysia, and India.

World alumina production gained 9%, as significant increases were made in Australia, Jamaica, and West Germany. Production in Japan and India declined. The United States remained the largest producer of alumina with 24% of the world total.

Table 18.—Bauxite: World production by country

(Thousand long tons)

Country [1]	1972	1973	1974 [p]
North America:			
Dominican Republic [2][3]	1,019	1,127	1,388
Haiti [4]	677	731	[e] 650
Jamaica [5]	12,345	13,385	15,086
United States [2]	1,812	1,879	1,949
South America:			
Brazil	[r] 752	639	[e] 650
Guyana [2]	3,291	3,224	[e] 3,100
Surinam	[r] 7,077	6,998	[e] 7,000
Europe:			
France	[r] 3,348	3,084	2,863
Germany, West	2	2	[e] 2
Greece	[r] 2,370	2,705	2,957
Hungary	2,321	2,559	2,708
Italy	95	49	31
Romania [e]	300	340	340
Spain	6	8	[e] 8
U.S.S.R. [e] [6]	4,100	4,200	4,200
Yugoslavia	2,162	2,133	2,333
Africa:			
Ghana	356	305	[e] 350
Guinea	2,018	[e] 3,000	[e] 6,500
Mozambique	5	6	[e] 3
Sierra Leone	683	593	661
Asia:			
China, People's Republic of [e] [7]	[r] 540	590	590
India	[r] 1,653	1,264	1,051
Indonesia	1,256	1,210	1,270
Malaysia (West Malaysia)	1,059	1,125	905
Pakistan	1	(8)	(8)
Turkey	[r] 464	[r] 347	654
Oceania: Australia	14,209	17,318	19,740
Total	[r] 63,921	[r] 68,821	76,989

[e] Estimate. [p] Preliminary. [r] Revised.

[1] In addition to the countries listed, Southern Rhodesia may have continued to produce bauxite during the period covered by this table; however, no information on bauxite mining activities, if any, has been available since 1965.

[2] Dry bauxite equivalent of crude ore.

[3] Shipments.

[4] Dry bauxite equivalent of ore processed by drying plant.

[5] Bauxite processed for conversion to alumina in Jamaica plus exports of kiln-dried ore.

[6] Excludes materials other than bauxite used for production of alumina, estimated as follows in thousand long tons: Nepheline syenite (25% to 30% alumina)—1972, 1,673; 1973, 2,116; 1974, 2,116; alunite ore (16% to 18% alumina)—1972, 492; 1973, 590; 1974, 590.

[7] Diasporic bauxite for production of aluminum only; excludes 100,000 to 200,000 tons of production for refractory applications.

[8] Less than ½ unit.

Table 19.—Alumina: World production by country

(Thousand short tons)

Country[1]	1972	1973	1974 [p]
North America:			
Canada	[r] 1,267	1,250	[e] 1,300
Jamaica (exports)	2,355	2,663	3,165
United States[2]	6,739	7,344	7,589
South America:			
Brazil	212	255	[e] 265
Guyana	287	285	354
Surinam	[r] 1,489	1,575	[e] 1,575
Europe:			
Czechoslovakia [e]	[r] 85	[r] 110	110
France	[r] 1,405	1,397	1,411
Germany, East	50	52	[e] 52
Germany, West	1,010	998	1,441
Greece	514	519	545
Hungary	573	722	764
Italy	227	537	[e] 800
Romania [e]	[r] 230	[r] 310	410
United Kingdom	128	107	[e] 110
U.S.S.R.[e]	2,500	2,600	2,600
Yugoslavia	[r] 139	303	[e] 330
Africa: Guinea	731	667	733
Asia:			
China, People's Republic of [e]	[r] 300	[r] 330	330
India [e]	[r] 401	[r] 346	282
Japan	1,813	2,190	1,985
Taiwan	58	[e] 60	[e] 60
Turkey	--	[3] 68	[3] 140
Oceania: Australia	3,382	4,437	5,397
Total	[r] 25,895	[r] 29,125	31,748

[e] Estimate. [p] Preliminary. [r] Revised.

[1] In addition to the countries listed, Austria produces alumina (fused aluminum oxide), but output is used entirely for abrasives production. Production was as follows in short tons: 1972—28,943; 1973—31,110; 1974—not available.

[2] Series revised to show calcined alumina equivalent; previous editions of this chapter have included figures on a gross weight basis.

[3] U.S.S.R. imports from Turkey; actual output may have been somewhat larger to provide raw material for an aluminum smelter due to begin operation in 1975.

Table 20.—World producers of alumina

(Thousand short tons)

Country, company, and plant location	Capacity yearend 1974	Ownership
NORTH AMERICA		
Canada: Aluminum Co. of Canada, Ltd., Arvida, Quebec	1,387	Alcan Aluminium Ltd. 100%.
Jamaica:		
Alcan Jamaica Ltd.:		Alcan Aluminium Ltd. 100%.
Ewarton, St. Catherine	624	
Kirkvine, Manchester	615	
Alcoa Minerals of Jamaica, Inc., Woodside, Clarendon	551	Aluminum Co. of America (Alcoa) 100%.
Alumina Partners of Jamaica, Nain, St. Elizabeth	1,300	Reynolds Metals Co. 36.8%, Anaconda Aluminum Co. 36.8%, Kaiser Aluminum & Chemical Corp. 26.4%.
Revere Jamaica Alumina, Ltd., Maggotty, St. Elizabeth	220	Revere Copper & Brass, Inc. 100%.
Total Jamaica	3,310	
United States (see table 6)	7,770	
Total North America	12,467	
SOUTH AMERICA		
Brazil:		
Alumínio Minas Gerais, S.A., Saramenha, Minas Gerais	100	Alcan Aluminium Ltd. 100%.
Cia. Brasileira de Aluminio, S.A., Sorocaba, São Paulo	110	Industria Votorantim, Ltd. 80%, Government, 20%.

See footnote at end of table.

Table 20.—World producers of alumina—Continued

(Thousand short tons)

Country, company, and plant location	Capacity yearend 1974	Ownership
SOUTH AMERICA—Continued		
Brazil—Continued		
Cia. Mineira de Alumínio, Poços de Caldas, Minas Gerais	[e] 75	Alcoa 50%, Hanna Mining Co. 23.5%, Brazilian interests 26.5%.
Total Brazil	285	
Guyana: Guyana Bauxite Co., Ltd., Mackenzie	390	Government 100%.
Surinam: Surinam Aluminum Co., Paranam	[e] 1,500	Alcoa 100%.
Total South America	2,175	
EUROPE		
Czechoslovakia: Ziar Banskobystricky	110	Government 100%.
France:		
Pechiney Ugine Kuhlmann Group:		Self 100%.
Gardanne	815	
Salindres	290	
La Barasse	330	
Total France	1,435	
Germany, East: V.E.B., Lauta	70	Government 100%.
Germany, West:		
Aluminium Oxid Stade GmbH, Stade	661	Vereinigte Aluminium-Werke AG (VAW) 50%, Reynolds 50%.
Gebrueder Giulini GmbH, Ludwigshafen	150	Self 100%.
Martinswerke GmbH für Chemische und Metallurgische Produktion, Bergheim	400	Swiss Aluminium Ltd. (Alusuisse) 99.2%.
Vereinigte Aluminium-Werke AG:		Government 100%.
Lippenwerke, Lünen	474	
Nabrewerk, Schwandorf	231	
Total West Germany	1,916	
Greece: Aluminium de Grèce S.A., Distomon	540	Pechiney Ugine Kuhlmann Group (PUK) 73%, Government and private Greek interests 27%.
Hungary:		Government 100%.
Ajka I	[e] 800	
Ajka II		
Almasfuzito		
Magyarovar		
Total Hungary	800	
Italy:		
Montecatini Edison, Porto Marghera	231	Self 89%, Government 11%.
Eurallumina S.p.A., Porto Vesme, Sardinia	794	Alsar S.p.A. 41.6%, Comalco Ltd. 20%, Metallgesellschaft A.G. 17.5%, Montecatini Edison 20.83%.
Total Italy	1,025	
Romania:		Government 100%.
Oradea	275	
Tulcea	275	
Total Romania	550	
United Kingdom: British Aluminium Co., Ltd., Burntisland	110	Tube Investments, Ltd. 52%, Reynolds 48%.
U.S.S.R.:		Government 100%.
Achinsk	[e] 3,500	
Dneprovsk		
Kamensk-Uralsky		
Kandalaksa		
Kirovabad		
Krasnoturinsk		
Novo Kuznetsk		
Pavlodar		
Pikalevo		
Sumgait		
Volgograd		
Volkhov-Tikhiun		
Total U.S.S.R.	3,500	

See footnote at end of table.

Table 20.—World producers of alumina—Continued

(Thousand short tons)

Country, company, and plant location	Capacity yearend 1974	Ownership
EUROPE—Continued		
Yugoslavia:		Government 100%.
Titograd, Montenegro	220	
Kidricevo, Slovenia	154	
Total Yugoslavia	374	
Total Europe	10,430	
AFRICA		
Guinea: Friguia, Kimbo	772	Frialco Co. 51%, Government 49%. (Frialco: Noranda Mines, Ltd. 38.5%, PUK 36.5%, British Aluminium 10%, Alusuisse 10%, VAW 5%).
Total Africa	772	
ASIA		
China, People's Republic of:		Government 100%.
Nanting, Fushun, and other locations	[e] 400	
India:		
Aluminium Corp. of India, Ltd.,		Self 100%.
Jaykaynagar, West Bengal	25	
Bharat Aluminium Co.,		Government 100%.
Korba, Madhya Pradesh	220	
Hindustan Aluminium Corp. Ltd.,		Birla and Indian interests 73%, Kaiser 27%.
Renukoot, Uttar Pradesh	200	
Indian Aluminium Co. Ltd.:		Alcan 55%, Indian interests 45%.
Muri, Bihar	85	
Belgaum, Mysore	125	
Madras Aluminium Co. Ltd.,		Madras State Government 73%, Montecatini Edison 27%.
Mettur, Tamil Nadu	55	
Total India	710	
Japan:		
Mitsui Aluminium Co., Ltd.,		Mitsui group 98.5%, other Japanese interests 1.5%.
Wakamatsu	220	
Nippon Light Metal Co. Ltd.:		Alcan 50%, Japanese interests 50%.
Shimizu	595	
Tomakomai	367	
Showa Denko K.K., Yokohama	683	Self 100%.
Sumitomo Chemical Co., Ltd.,		Self 100%.
Kikumoto	844	
Total Japan	2,709	
Taiwan: Taiwan Aluminium Corp.,		Government 100%.
Kaoshiung	84	
Turkey: Seydisehir	220	Government 100%.
Total Asia	4,123	
OCEANIA		
Australia:		
Alcoa of Australia (W.A.) Ltd:		Alcoa 51%, Australian interests 49%.
Kwinana, Western Australia	[e] 1,400	
Pinjarra, Western Australia	[e] 1,100	
Nabalco Pty. Ltd.,		Alusuisse 70%, Gove Alumina Ltd. 30%.
Gove, Northern Territory	1,100	
Queensland Alumina Ltd.,		Kaiser 32.3%, Alcan 21.4%, PUK 20%, Comalco 13.8%, Conzinc Riotinto of Australia, Ltd. 12.5%, (Comalco: Conzinc Riotinto of Australia 45%, Kaiser 45%, public 10%).
Gladstone, Queensland	2,205	
Total Oceania	5,805	
Total World	35,772	

[e] Estimate.

Australia.—Bauxite production in Australia, the world's largest producer, has increased from 30,000 long tons in 1962 to about 20 million tons in 1974. Alumina production has grown from 38,000 short tons to 5.4 million tons over the same period.

In 1974 Alcoa of Australia (W.A.) Ltd. operated alumina plants at Kwinana and Pinjarra in Western Australia, using bauxite from mines in the Darling Range. The capacity of the Pinjarra plant was expanded to an estimated 1.1 million short tons per year, and further expansion should increase capacity to about 2.2 million tons by the end of 1976.

The Comalco Ltd. bauxite mining operation at Wiepa, Queensland, continued to be the largest in the world. Shipments of beneficiated bauxite increased to 9.3 million tons, of which 4.0 million tons went to the Gladstone alumina plant in Queensland, 1.6 million tons to Japan, and 3.7 million tons to Europe and other areas, including 1.2 million tons to the Eurallumina S.p.A. plant in Sardinia, Italy. A second calcining kiln was completed to meet rising sales of calcined abrasive-grade bauxite. Legislation by the Government of Queensland imposed higher royalties on bauxite from Wiepa beginning in August 1974. The new regulations raised royalties 10-fold to $A0.50 on bauxite converted to alumina in Queensland and $A1.00 on exported bauxite (yearend rate of exchange: $A1.00=US$1.33). The increase was unsuccessfully challenged in the Supreme Court of Queensland.

Although labor problems at Wiepa and striking marine engineers curtailed receipts of bauxite at the Gladstone alumina plant and caused production to be cut to less than half capacity in July, alumina output for the year again exceeded designed annual capacity. It was announced that Howmet Corp., a subsidiary of Pechiney Ugine Kuhlmann (PUK), would purchase PUK's 20% direct interest in Queensland Alumina Ltd., owners of the Gladstone plant.

Nabalco Pty. Ltd., increased its production of bauxite at Gove, Northern Territory, from about 3.1 million long tons in 1973 to 3.9 million tons in 1974. Nearly half of the bauxite was exported, principally to Japan and Europe, and the remainder was used at the Gove alumina plant. Alumina production rose to 905,000 short tons.

Financing and environmental problems continued to delay the proposed Alwest bauxite and alumina project in southern Western Australia during the year. Estimates of the cost of the 1-million-ton-per-year complex rose to $500 million.

Brazil.—Extensive exploration for bauxite has taken place in the Amazon basin in recent years. Estimates of the potential of known bauxite occurrences in 1974 ranged from 2 to 5 billion tons. Three areas in which major discoveries had been made were the Trombetas area, near the confluence of the Trombetas and Amazon Rivers in the State of Pará, the Paragominas area, south of Belem and east of the Tocantins River in Pará, and the Jari area, along the southern end of the Jari River bordering the States of Amapá and Pará.

Mineração Rio do Norte, S.A., which holds the reserves discovered by Alcan Aluminium Ltd. in the Trombetas area, was expected to be the first company to produce bauxite in the Amazon basin. At yearend, production at the rate of 3.3 million tons per year by 1979 was planned. The company is owned 41% by the Government's Cia. Vale do Rio Doce (CVRD), 10% by the privately owned Brazilian company Cia. Brasileira de Aluminio, S.A., 19% by Alcan, 5% by Reynolds, and 5% each by five European companies.

CVRD also owned bauxite properties in the Paragominas area near the Belem-Brasilia highway. Other companies also held bauxite concessions in both the Trombetas and Paragominas areas. A discovery of low-iron bauxite possibly suitable for refractory use was reported in the Paragominas area.

Ethyl Corp. announced discovery of large high-grade bauxite deposits close to deep water in the Jari area of Amapá. Evaluation and engineering work on these deposits was expected to continue through 1976.

CVRD and the Light Metal Smelters Association of Japan, a consortium of five Japanese companies, agreed to form a jointly owned company, Alumínio do Brazil (Albras), to establish an aluminum complex based on bauxite from the Trombetas area. Brazilian interests would have majority ownership of Albras. The proposed complex would be located near

Belem and would include an alumina plant of 1.4 million short tons annual capacity, an aluminum plant of 660,000 tons' capacity, hydroelectric power facilities, and infrastructure.

Dominican Republic.—The Government of the Dominican Republic and Alcoa reached an accord at yearend which reportedly would more than double the revenues paid to the Government on bauxite production. The Government announced that retroactive to April 1, 1974, Alcoa would pay a royalty on bauxite production based on a rate of 5.5% of the average price obtained for primary aluminum. The announcement stated that the agreement would be provisional until Alcoa's dispute on the terms of taxation on bauxite production in Jamaica has been settled. At that time Alcoa would pay retroactive to April 1, 1974, the difference between the tax rate to Jamaica and that paid under the provisional agreement to the Dominican Republic if the Jamaican tax rate were higher. The provisional agreement also included revisions in the method of calculating earnings for income tax purposes.

French Guiana.—Alcoa announced in January 1974 that it would not go ahead with development of bauxite deposits in French Guiana, and its options were allowed to lapse.

Ghana.—The Government of Ghana and Bauxite Alumina Study Co. Ltd. (Bascol) signed a letter of intent in May concerning the development of bauxite mining in the Kibi area and the construction and operation of a 600,000-ton-per-year alumina plant. Bascol was owned by Kaiser Aluminum & Chemical Corp. and Aluminum Resources Development Co. (Ardeco), a consortium of five Japanese aluminum companies. Bascol launched a feasibility study which it expected to complete by the middle of 1975. If the project is feasible, half the output of the alumina plant would be used to supply the Volta Aluminium Co., Ltd. (Valco) smelter, and half would be exported. The Government would have a 30% equity in the complex, and Bascol would own 70%. The total cost of the project was estimated at $160 million.

Greece.—In anticipation of increased demand for bauxite, Bauxites Parnasse Mining Co., the largest bauxite producer in Greece, announced plans for expandng its mining, beneficiating, and shipping facilities. Eleusis Bauxite Mines, Inc., the second largest producer, began operation of a new bauxite dressing plant and had another under construction. The Government's bauxite export quota was increased from 1,831,000 long tons in 1973 to 3,036,000 tons in 1974 and 3,105,000 tons for 1975.

None of the proposals to construct additional alumina plants in Greece, which involved Alcoa, Reynolds, PUK, Bauxites Parnasse, and the Greek and Soviet governments, resulted in firm plans for construction by the end of 1974. Bauxite Parnasse was reportedly completing a feasibility study for a plant with annual capacity of 660,000 short tons.

Guinea.—Estimated bauxite production in Guinea increased over 100% in 1974. It was the first full year of production at the Boké project operated by Guinea Bauxite Co. (CBG), and output by this venture alone exceeded 4 million tons. CBG was owned by the Government of Guinea (49%) and Halco (51%), a consortium of aluminum producers consisting of Alcoa (27%), Alcan (27%), Martin Marietta Aluminum, Inc. (20%), PUK (10%), Vereinigte Aluminium-Werke AG (VAW) (10%), and Montecatini Edison (6%).

Bauxite was also mined by Friguia, which continued to operate the only alumina plant in Africa. Friguia was owned by the Government (49%) and Frialco Co. (51%), an international consortium consisting of Olin Corp. (38.5%), PUK (36.5%), British Aluminium (10%), Swiss Aluminium Ltd. (Alusuisse) (10%), and VAW (5%). Late in the year Olin sold its equity in Frialco to Noranda Mines, Ltd., which has a primary aluminum plant in the United States.

A third bauxite producer, the Government's Kindia Bauxite Office (OBK), began mining the deposits at Debele in the Kindia region in 1974. This project was initiated with technical assistance and financing by the U.S.S.R. All of the production, which was expected to reach 2.5 million tons per year, was to be exported to the U.S.S.R.

The Government and Alusuisse joint venture, Société Mixte Guinée Alusuisse (SOMIGA), was reportedly developing bauxite deposits in the Tougue region. Alusuisse reported that prospecting revealed over 2 billion tons of commercial-grade bauxite in this area. Another potential producer, Dabola Bauxite Co. (SBD), expected to complete feasibility studies in 1975 on its project near Dabola. SBD was a joint venture of the Governments of Guinea and Yugoslavia.

Guyana.—Bauxite was mined by Reynolds Guyana Mines, Ltd., and the Government-owned Guyana Bauxite Co. Ltd. (Guybau), which also produced alumina. Guybau reported a decline in its output of dried bauxite to 743,000 long tons, and production increases to 686,000 long tons of calcined bauxite and 348,000 short tons of calcined alumina. During the year Guybau was obtaining financing to expand its bauxite mining and calcining facilities.

In September the Government enacted legislation to impose a levy on metallurgical-grade bauxite, retroactive to January 1, 1974, similar to that enacted earlier by the Government of Jamaica. The new levy was based on a rate of 5.9% of the realized price of primary aluminum. Intentions to nationalize the Reynolds operations were announced by Government officials early in 1974. On December 31, 1974, the Government and Reynolds signed an agreement on a settlement of the levies and other taxes owed by Reynolds and the purchase of Reynolds facilities by the Government. Reynolds was to receive compensation based on the book value of its assets, approximately $14.5 million, less the agreed-upon taxes due the Government.

Haiti.—In December Reynolds Metals Co. and the Government of Haiti reached agreement on a basis for computing a severence tax on bauxite shipments for 1974. The new rate per long dry ton of bauxite was 6.3% of the average realized price per short ton of primary aluminum ingot divided by 4.32. If, for example, the average realized price of aluminum was assumed to be 34 cents per pound, the tax would be $9.92 per ton of bauxite. According to reports, a royalty of 50 cents per ton of bauxite was also applicable. Further negotiations were expected in 1975 to establish final agreement on tax rates.

Hungary.—The Government announced that the Almasfuzito alumina plant would be expanded and would reach an annual capacity of 358,000 short tons by 1976.

India.—Bharat Aluminium Co. planned to build a 220,000-ton-per-year alumina plant at Bhuj, Gujarat, with financial assistance from Iran and possible participation by the Gujarat Mineral Development Corp. The plant would produce alumina for export to Iran. A feasibility study for setting up a 550,000-ton plant to use bauxite deposits in Madhya Pradesh was being prepared by the U.S.S.R. New bauxite discoveries, potentially very large, were reported by the State of Orissa.

Ireland.—In February Alcan Aluminium Ltd. announced that it planned to construct an alumina plant, with a capacity of 880,000 tons per year, on Aughinish Island in an estuary of the Shannon River about 18 miles from Limerick. Bauxite for the plant is to be imported, mainly from West Africa, and alumina production is to be exported to other European countries. It was expected that Alcan would own at least 70% of the equity and A/S Årdal og Sunndal Verk (ASV) of Norway and Gränges Essem AB of Sweden would own the remainder. Scheduled completion of the plant was subsequently postponed from 1978 to 1980, and by yearend estimates of cost had risen to $350 million.

Jamaica.—Bauxite production in Jamaica, the world's second largest producer, increased 13%, and alumina exports increased 19%. All of the bauxite and alumina was produced by affiliates of six North American aluminum companies. In addition to the bauxite produced to supply the alumina plants on the island, Jamaican bauxite was exported, largely to plants in the United States, by Kaiser Bauxite Co., Reynolds Jamaica Mines Ltd., and Alcoa Minerals of Jamaica, Inc.

Early in 1974 the Government of Jamaica requested discussions with the bauxite producers on increasing the Government's revenues from bauxite production and on increasing the Government's control and participation in the development of Jamaica's bauxite resources. Representatives of the Government and the producers held a series of meetings but were unsuccessful in renegotiating existing bauxite tax agreements.

In June, the Jamaican Government enacted legislation imposing a new bauxite production levy, retroactive to January 1, 1974. The new levy was based on a percentage of the realized price on primary aluminum. The applicable rate was set initially at 7.5% and was scheduled to increase to 8.0% on April 1, 1975, and 8.5% on April 1, 1976. To calculate the levy on bauxite, the average realized price per ton of aluminum would be multiplied by the rate, divided by a factor of 4.3, and multiplied by the tonnage of bauxite. Estimates of the levy to be applied in 1974 ranged from $11 to $13 per ton, depending on the assumed price of aluminum. In addition to the levy, the royalty on bauxite production was increased to $0.55 per ton. Jamaican taxes and royalties in 1973 reportedly averaged about $2 per ton. The new bauxite legislation also specified minimum production levels for each producer.

The producers made quarterly payments on the required new levies, under protest, claiming violation of previous agreements on taxation. Three of the companies filed requests for arbitration with the World Bank's International Center for Settlement of Investment Disputes (ICSID). The Jamaican Government asserted that ICSID had no jurisdiction in these disputes.

In the last quarter of 1974, the Government began negotiations, on a company-by-company basis, to acquire equity participation in bauxite mining, ownership of bauxite lands, and control of mining rights. An agreement was reached with Kaiser whereby Kaiser would sell the Government at book value its bauxite lands (40,000 acres) and a 51% interest in its mining assets. The Government agreed to provide a 40-year reserve of bauxite at the current rate of extraction under a land leasing arrangement and to adjust the bauxite levy by keeping it at 7.5% for 3 years and at 1% less than the national levy for 2 additional years.

By yearend, a preliminary agreement had also been reached with Revere Jamaica Alumina, Ltd., which would provide for the purchase of Revere's bauxite land by Jamaica, a lease back of reserves, and a Government and Revere mining partnership. The Government may also participate along with six Japanese companies in a proposed expansion of Revere's Maggotty alumina plant. The alumina plant expansion by the Japanese participants would be to provide alumina for a proposed expansion of a primary aluminum plant at Scottsboro, Ala. Feasibility studies were in progress.

The Governments of Jamaica and Mexico agreed to establish an integrated bauxite, alumina, and aluminum complex as a joint venture. Announced plans included a bauxite mine to produce at least 1.3 million tons per year, a caustic soda plant, and an alumina plant of 600,000 to 800,000 tons' annual capacity, all of which will be located in Jamaica, and an aluminum smelter of 132,000 short tons' annual capacity to be built in Mexico. Jamaica will have a majority interest and Mexico a minority interest in the Jamaican facilities, and Mexico will have a majority interest and Jamaica a minority interest in the smelter.

Another bauxite-to-aluminum joint venture being studied involved Jamaica, Guyana, and Trinidad and Tobago. Bauxite and alumina would be supplied by Jamaica and Guyana, and a smelter, which would use natural gas from Trinidad for power, would be constructed at Point Lisas, Trinidad.

Japan.—Japan continued to be one of the five largest consumers of bauxite and was entirely dependent on imports for its supply. Imports declined 5% in 1974 to 5.2 million long tons. Over half of the imports came from Australia, and Indonesia and Malaysia provided most of the remainder. Alumina production by each of the three leading producers declined, but Mitsui Alumina Co. showed a slight increase. Mitsui announced that it planned to double the capacity of its alumina plant at Wakamatsu by 1976.

Philippines.—A consortium of eight foreign companies, led by Comalco Ltd. of Australia, was considering the possibility of constructing an alumina plant on Mindanao. The proposed plant would have an initial annual capacity of 880,000 short tons, would begin production in 1980, and would use bauxite from Wiepa, Australia. Comalco decided in 1973 that it was uneconomic to construct the plant at Wiepa.

Poland.—It was reported that a plant will be constructed in the province of Kielce to produce alumina from local nonbauxitic materials.[8] The plant will use the Grzymek process, developed in

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[8] American Metal Market. Plant in Poland Will Produce Aluminum Without Using Bauxite. V. 81, No. 110, June 6, 1974, p. 13.
———. Poland Works at Its Aluminum Raw Materials Problems. V. 80, No. 135, July 12, 1973, p. 8.

Poland, which produces large quantities of cement as a coproduct.

Sierra Leone.—Alusuisse, the only bauxite producer in Sierre Leone, reported that it had confirmed substantial quantities of easily accessible bauxite in a new area near Port Loko.

Spain.—Concern about possible pollution of estuary and coastal waters by a proposed alumina plant at Villagarcia de Arosa resulted in the selection of a new plant site at San Cipriano in the Province of Lugo. The relocation was expected to delay initial production at the plant until the end of 1977. The plant will eventually have a capacity of 880,000 tons per year. It will be operated by Aluminio Español S.A., which will be owned by two Spanish aluminum companies, Empresa Nacional del Aluminio, S.A., 55%, and Aluminio de Galicia, S.A., 45%.

Surinam.—Bauxite was mined by Surinam Aluminum Co. (Suralco), an Alcoa subsidiary, and N.V. Billiton Maatschappij Suriname. Suralco also produced alumina and aluminum and converted bauxite to alumina for Billiton. Exports of bauxite, most of which was shipped to the United States, increased 3% in 1974. Alumina exports declined 11% and went largely to Europe and the United States.

In December, Suralco and the Government of Surinam signed an interim agreement which would increase bauxite revenues paid to the Government to about $10 per ton retroactive to January 1, 1974. Previous revenues from bauxite have been estimated at $2.50 per ton. Under the agreement, which was effective through 1975, the new bauxite levy will be calculated on the basis of 6% of the average annual price realized by Alcoa on unalloyed aluminum ingot.

Alcan Aluminium Ltd. and Billiton signed a joint venture agreement in July to establish a new company, Alcan Billiton Suriname N. V. (ABS), which will construct and operate a bauxite calcining plant at Smalkalden. The agreement gave the Surinam Government an option on one-third of the equity in the venture. Annual plant capacity was expected to be 150,000 tons of calcined bauxite, and production was scheduled to begin in 1976.

Reynolds Metals Co., which had been exploring for bauxite in western Surinam under a joint venture with the Government, relinquished its concession and export rights. In acquiring ownership of the venture, the Government agreed to compensate Reynolds $3.5 million.

U.S.S.R.—PUK was reported to have concluded an agreement with the U.S.S.R. to construct an aluminum complex which will include a 1-million-ton-per-year alumina plant on the Black Sea.

Yugoslavia.—Three new alumina plants were under construction in 1974. The plant of Energoinvest being built at Bacevici near Mostar, Bosnia-Hercegovina, was believed to be near completion at yearend. It will have an annual capacity of 310,000 short tons. A larger Energoinvest alumina plant of 660,000 tons' capacity was under construction at Zvornik, Bosnia-Hercegovina. This plant, which will use bauxite from Vlasenica, was expected to be completed in 1976. A third alumina plant, also scheduled for 1976, will be located at Obrovac in the northern Dalmatia part of Croatia. It will be part of the Zaton aluminum complex and reportedly will have a capacity of 330,000 tons.

TECHNOLOGY

Theories on the origin of Jamaican bauxite were reviewed.[3]

The oil embargo and subsequent increases in oil prices implemented by oil-producing countries generated considerable interest in energy consumption and conservation in all phases of the aluminum production process. Estimates of energy requirements are given in the Aluminum chapter.

Alcoa's development of fluid-flash calciners for alumina plants was described.[4] Alcoa reported that its latest model calciner requires about 1,400 Btu to calcine 1 pound of alumina, a savings of 30% to 40% in fuel requirements compared with rotary calcining kilns.

Increased costs of foreign bauxite stimulated greater interest in the development of processes to use low-grade domestic aluminum resources. Some of the nonbauxitic resources were described.[5]

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[3] Comer, J. B. Genesis of Jamaican Bauxite. Econ. Geol., v. 69, No. 8, December 1974, pp. 1251–1264.

[4] Fish, W. M. Alumina Calcination in the Fluid-Flash Calciner. Light Metals, v. 3, 1974, pp. 673–682 (Proceedings of Sessions, 103d AIME Annual Meeting).

Reynolds Metals Co. demonstrated that alumina could be produced from domestic bauxitic laterite in existing Bayer-process plants without any alteration of the facilities. The successful demonstration was conducted at the Hurricane Creek, Ark., plant of Reynolds in March using laterite mined in 1970 at its properties in Oregon and Washington. About 3 tons of laterite was required to produce 1 ton of alumina, compared with slightly over 2 tons of bauxite. The resulting loss of capacity could be compensated by adding more digesting equipment at the beginning of the process.

A joint venture of Earth Sciences, Inc., National Steel Corp., and Southwire Co. continued tests at its Alumet pilot plant at Golden, Colo., on the recovery of alumina and fertilizer byproducts from alunite. Testing and feasibility studies were expected to be completed in 1975. Although a decision to proceed with a commercial venture had not been reached at the end of 1974, a proposed project would produce annually 500,000 tons of alumina, 250,000 tons of potassium sulfate, and 550,000 tons of triple superphosphate. The project would include the mining of over 3.5 million tons per year of alunite from extensive reserves near Cedar City, Utah. The companies involved in the project have also acquired leases on phosphate rock properties in southern Idaho and on coal in central Utah.

Alcan and PUK agreed to join in the development of a process, known as the H-Plus process, for extracting alumina from clays, shales, and other nonbauxitic raw materials. The H-Plus process uses both sulfuric acid and hydrochloric acid. A pilot plant capable of producing 20 tons of high-grade alumina per day was scheduled to be constructed near Marseilles, France, by the end of 1976.

Alcoa announced that it was expanding its research on alternate domestic raw materials and that it was considering the use of residues from coal and oil shale processing. Alcoa also held large reserves of anorthosite in Wyoming. Reports were published describing the aluminum potential of oil shales in the Piceance Creek Basin of Colorado.[6]

The Bureau of Mines in a cooperative project with industry continued its miniplant research to test and develop the most promising technologies for recovering alumina from domestic nonbauxitic resources and to provide engineering data and cost assessments for the various processes. The resources selected for testing were clay, anorthosite, alunite, and dawsonite. Other raw materials may be added. The miniplant program was based in part on a series of conjectural cost estimates for processes to recover alumina from clay and other domestic resources. These estimates were updated in June 1974[7] and require frequent review because of changing costs of energy and other materials. Eight aluminum companies joined with the Bureau in the miniplant project on a cooperative basis, effective July 1, 1974.

Miniplants to test the processes will be located at the Bureau's Boulder City, Nev., laboratory, and supporting research will be provided by other metallurgical facilities of the Bureau. The first miniplant, which was designed to process kaolinitic clay by leaching with nitric acid, was installed and operated during 1974. The second process, scheduled to begin in the latter part of 1975, will leach clay with hydrochloric acid.

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[5] Husted, J. E. Potential Reserves of Domestic Nonbauxitic Sources of Aluminum. Light Metals, v. 3, 1974, pp. 691–711 (Proceedings of Sessions, 103d AIME Annual Meeting).

[6] Rothberg, P. F. Aluminum and Sodium Minerals From Oil Shale. Rept. Prepared for the Subcommittee on Mines and Mining of the Committee on Interior and Insular Affairs, U.S. House of Representatives, 1974, 55 pp.

Beard, T. N., D. B. Tait,, and J. W. Smith. Nahcolite and Dawsonite Resources in the Green River Formation, Piceance Creek Basin, Colorado. Rocky Mountain Assoc. of Geologists Guidebook, 1974, pp. 101–109.

[7] Peters, F. A., and P. W. Johnson. Revised and Updated Cost Estimates for Producing Alumina From Domestic Raw Materials. BuMines IC 8648, 1974, 51 pp.

Beryllium

By Benjamin Petkof [1]

Consumption of beryllium ore increased almost 7% above that of 1973. Imports of beryl decreased for the fifth consecutive year, and exports of beryllium products increased. Domestic production of bertrandite continued to provide an increasing proportion of world beryllium requirements.

Table 1.—Salient beryllium mineral statistics

	1970	1971	1972	1973	1974
United States:					
Beryl, approximately 11% BeO:					
Shipped from mines -- short tons --	W	W	W	W	--
Imports ---------------------- do ----	4,942	4,026	3,345	1,586	1,368
Consumption [1] -------------- do ----	9,496	10,373	7,781	8,695	9,279
Price, approximate, per unit BeO imported cobbed beryl at port of exportation ----------------------	$35	$33	$30	$30	$30
Bertrandite ore: Utah, low-grade, shipped from mines ----- short tons --	W	W	W	W	W
World production of beryl ---------- do ----	6,857	5,791	[r] 4,330	[r] 3,963	3,977

[r] Revised. W Withheld to avoid disclosing individual company confidential data.

[1] Includes bertrandite ore which was calculated as equivalent to beryl containing 11% BeO.

Legislation and Government Programs.—The General Services Administration removed beryl and beryllium-copper master alloy from the list of strategic and critical materials in 1973 but retained beryllium metal on the list. Although published beryllium stockpile data showed some variation from yearend 1973 to yearend 1974, no beryllium materials were released from the stockpile in 1974.

The Environmental Protection Agency (EPA) announced in the Federal Register of May 3, 1974, that beryllium emissions resulting from the incineration of sewage sludge were being studied and the EPA would determine whether it is necessary to regulate this hazardous pollutant source to provide an ample margin of safety to protect the public health.

DOMESTIC PRODUCTION

The Brush Wellman, Inc. (Brush) bertrandite mine at Spor Mountain near Delta, Utah, was the only reported domestic source of beryllium minerals in 1974.

During 1974, Brush mined enough bertrandite to maintain a 2-year supply of raw materials for its operations. In August 1974, Brush initiated a third major overburden removal program to expose additional ore for future feedstock. Completion is anticipated by mid-1975 at an estimated cost of $3.4 million. The company's beryllium facilities included plants at Delta, Utah, and Elmore, Ohio, to convert bertrandite and beryl to beryllium hydroxide. The Elmore plant also has manufacturing and fabrication facilities for beryllium metal, beryllium-copper master alloy, and beryllium oxide ceramics. Brush also conducted field examinations of several areas of potential beryllium mineralization.

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[1] Physical scientist, Division of Nonferrous Metals.

Kawecki Berylco Industries, Inc., used imported beryl as its primary raw material. The company processed beryllium materials at its plants in Hazelton and Reading, Pa., into beryllium metal, copper master alloy, nickel, aluminum alloy, and oxide. Early in 1974, the company began operation of a new mechanical cleaning line at its Reading plant to rapidly and uniformly remove oxide films from the surfaces of beryllium-copper and beryllium-nickel strip after annealing.

CONSUMPTION AND USES

The beryllium industry consumed beryllium ore equivalent to 9,279 short tons of beryl containing 11% BeO, compared with 8,695 tons in 1973.

Beryllium metal is consumed where a high stiffness-to-weight ratio is required. The metal is used in applications such as optics, X-ray transmission windows, aircraft brakes, missile parts, and nuclear structures.

Products fabricated with beryllium-copper alloys accounted for the largest quantity of beryllium consumption. Increasing applications for these alloys were found in the business machine, appliance, transportation, and communication industries. Beryllium-copper alloys were also widely used in electrical and electronic systems for connectors, sockets, switches, and temperature- and pressure-sensing devices to provide reliability and long service life.

Beryllium oxide ceramics were used in devices such as lasers, microwave tubes, and semiconductors. Typical applications included power amplifiers for microwave and radio communications, electronic ignition systems, and power regulators.

STOCKS

Consumer stocks of hand-sorted beryl at the end of 1974 totaled 4,436 short tons, compared with 5,894 short tons at yearend 1973. Dealers' stocks of beryl were not reported.

PRICES AND SPECIFICATIONS

There were no known price quotations for domestically produced beryl. The price of available domestic beryl was negotiated between buyer and seller. Metals Week quoted the price of imported beryl at $30 per short ton unit from March to December 1974. Prior to March 1974, the price ranged from $30 to $35 per short ton unit. Published quotations for beryllium materials showed small fluctuations during 1974, and at yearend the following prices were quoted for metallic beryllium: Vacuum-cast ingot, $75 per pound; beads (97% purity), $61 per pound; powder, $56 to $63.50 per pound; and rod, $106 to $122 per pound.

Also at yearend, beryllium-copper master alloy was quoted at $59 per pound of contained beryllium metal. Beryllium-copper casting ingot (2% to 2.25% beryllium in copper) was quoted at $2.46 per pound; beryllium-copper in strip, rod, bar, and wire, $3.69 to $3.78 per pound; and beryllium-aluminum alloy ingot, $72 per pound.

FOREIGN TRADE

Exports of beryllium alloys and waste and scrap increased 32% in quantity but declined 9% in value from those of 1973. The average value of exports was $7.71 per pound in 1974, compared with $11.17 per pound in 1973 and $8.79 per pound in 1972, indicating greater quantities of scrap exported. Almost 93% of total exports were shipped to West Germany, Canada, Japan, and France.

Imports of beryl decreased for the fifth consecutive year and declined 14% in both quantity and value from those in 1973. The average value of imported beryl was $303 per short ton, unchanged from the previous year. Almost three-fourths of U.S.

imports originated in Brazil (44%), the Republic of South Africa (20%), and Uganda (10%). In addition, 20,518 pounds of wrought, unwrought, and waste and scrap beryllium metal valued at $211,302 were imported.

Table 2.—U.S. exports of beryllium alloys, wrought or unwrought, and waste and scrap [1]

Country	1973		1974	
	Quantity (pounds)	Value (thousands)	Quantity (pounds)	Value (thousands)
Brazil	4,536	$14	2,000	$8
Canada	6,736	104	41,008	69
Denmark	45	2	--	--
France	2,723	132	10,223	509
Germany, West	20,258	137	64,271	101
Ghana	--	--	500	2
India	4	2	10	2
Israel	--	--	5	1
Italy	--	--	21	6
Japan	60,412	402	17,466	215
Korea, Republic of	--	--	29	3
Mexico	22	1	3,896	7
Netherlands	17	([2])	11	6
Netherlands Antilles	6,220	18	--	--
Spain	--	--	22	1
Switzerland	934	25	1,531	26
Taiwan	2,126	3	--	--
United Kingdom	5,166	380	2,635	151
Total	109,199	1,220	143,628	1,107

[1] Consisting of beryllium lumps, single crystals, powder, beryllium-base alloy powder, beryllium rods, sheets, and wire.

[2] Less than ½ unit.

Table 3.—U.S. imports for consumption of beryl, by customs district and country

Customs district and country	1973		1974	
	Quantity (short tons)	Value (thousands)	Quantity (short tons)	Value (thousands)
Philadelphia district:				
Angola	77	$19	--	--
Argentina	138	31	83	$22
Australia	116	37	66	21
Brazil	862	272	607	215
Malagasy Republic	13	5	--	--
Mozambique	--	--	27	7
Portugal	13	3	88	13
Rwanda	67	12	44	12
South Africa, Republic of	300	102	280	87
Uganda	--	--	136	30
United Kingdom	--	--	19	4
Total	1,586	481	1,350	411
New York City district: Rwanda	--	--	18	3
Grand total	1,586	481	1,368	414

WORLD REVIEW

World production of beryl increased slightly in 1974. The United States continued to make a significant contribution to the world beryllium mineral supply.

Table 4.—Beryl: World production by country
(Short tons)

Country [1]	1972	1973	1974 [p]
Angola	193	127	[e] 110
Argentina	93	204	[e] 205
Australia	68	179	[e] 190
Brazil	[r] 1,709	1,334	[e] 1,200
Malagasy Republic	10	3	14
Mozambique	9	1	[e] 1
Portugal	19	3	[e] 3
Rhodesia, Southern [e]	65	65	70
Rwanda	114	105	[e] 100
South Africa, Republic of	276	57	4
Uganda	68	[e] 65	[e] 60
U.S.S.R.[e]	1,500	1,600	1,800
United States	W	W	W
Zaire	(2)	(2)	--
Zambia	206	[e] 220	[e] 220
Total	[r] 4,330	3,963	3,977

[e] Estimate. [p] Preliminary. [r] Revised. W Withheld to avoid disclosing individual company confidential data.

[1] In addition to the countries listed, the Territory of South West Africa may also have produced beryl, but available information is inadequate to formulate reliable estimates of output levels.

[2] Revised to zero on the basis of official Zairian publications.

Brazil.—A paper was published describing the locations of Brazil's beryl deposits.[2]

India.—Recent reevaluations supported earlier reports that indicated the country's beryl ore reserves were sufficient for a sustained production of 2,000 tons per year. Despite this, beryl is not currently mined except as a small undeclared coproduct from mica mining or gem beryl recovery.

The Indian Government classifies beryl as a strategic mineral and regulates stocks and exports of any available beryl through its Department of Atomic Energy. This agency has control of mine production, specifications, and purchases of domestically mined beryl.

Uganda.—A recent paper described the beryl deposits of the country and techniques for their evaluation. The work led to a standard procedure for prospecting and evaluating the country's beryl deposits.[3]

TECHNOLOGY

Applications of beryllium in aerospace structures, aircraft turbines, neutron moderators and reflectors in reactors, fuel elements, neutron sources, X-ray windows, and alloys were described and discussed.[4]

A definitive review of beryllium discussing the occurrence and reserves of beryllium minerals, production of metals, alloys and compounds, international trade, uses, and prices was published.[5]

Factors affecting the strength and ductility of high-purity, hot isostatically pressed beryllium block were studied. Residual cold work was identified as the factor causing reduced ductility in the highest purity material after hot pressing. A marked increase in ductility was obtained by high-temperature annealing. Annealing between 2,200° F and 2,275° F produced hexagonal-shaped voids and decreased tensile ductility. Above 2,275° F, voids were not hexagonal and were smaller in size.[6]

A method was developed to make beryllium oxide trace determinations in biological samples. This method may find application involving long exposure to beryllium oxide emission products.[7]

Recent literature was reviewed on beryllium powder, metallurgy, melting and casting, wrought beryllium products, joining techniques, corrosion and surface treatment, purification, lattice defects, mechanical behavior, fracture, phase studies, physical and chemical properties, composite materials, properties, and applications and toxicology.[8]

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[2] Sinkankus, J. Beryl in Brazil. Lapidary J., v. 28, No. 2, May 1974, pp. 324–332.

[3] Reedman, A. J. Prospection and Evaluation of Beryl Pegmatites in Southwest Uganda. Nat. Environment Res. Council, Inst. Geol. Sci., Overseas Geol. and Miner. Res. No. 41 (Her Majesty's Stationery Office), 1973, pp. 86–100.

[4] Greenfield, P. Engineering Applications of Beryllium. Mills and Boon Ltd., London, 1971, 52 pp.

[5] Roskill Information Services Ltd., Beryllium, Survey of World Production, Consumption and Prices. London, December 1974, 75 pp.

[6] Webster, D., R. L. Greene, and R. W. Lawley. Factors Controlling the Strength and Ductility of High-Purity Beryllium Block. Met. Trans., v. 5, No. 1, January 1974, pp. 91–96.

[7] Frame, G. M., R. E. Ford, W. G. Scribner, and T. Ctvrtnicek. Trace Determination of Beryllium Oxide in Biological Samples by Electron-Capture Gas Chromotography. Anal. Chem., v. 46, No. 4, April 1974, pp. 534–539.

The domestic beryllium minerals resource position was reviewed by a Geological Survey publication.[9]

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[8] Aldinger, F. Research and Development in Beryllium Materials. Powder Met. Internat., v. 6, No. 2, 1974, pp. 97–100.

[9] Griffiths, W. R. Beryllium. Ch. in United States Mineral Resources. Geol. Survey Prof. Paper 820, 1973, pp. 85–93.

Bismuth

By Charlie Wyche [1]

Sharp declines in production, consumption, and imports, unusually high prices, and increased exports characterized the domestic bismuth industry in 1974. Consumption of refined bismuth dropped some 600,000 pounds, to 21% below the 1973 consumption level, approximating the average annual amount for 1970–73. The decline in the quantity of metal used in the three major consuming categories reflected decreased availability of bismuth and the necessity of substitution under the existing market condition. A strong European demand affected world trade and resulted in a 29% decrease in domestic metal imports.

Prices fluctuated widely during the year, reaching a record high of $12 per pound by midyear. Consumer resistance, however, developed in late summer, causing a downward trend in the price to $9 per pound by yearend. World mine production showed a moderate gain because the drop in production in Japan was more than offset by increases in Mexico and Peru.

Table 1.—Salient bismuth statistics
(Pounds)

	1970	1971	1972	1973	1974
United States:					
Consumption	2,209,641	1,648,718	2,315,534	2,906,219	2,283,978
Exports [1]	910,275	71,187	264,276	151,053	329,926
Imports, general	997,924	848,708	1,562,934	r 2,683,671	1,893,744
Price: New York, per pound, average ton lots	$6.00	$5.26	$3.63	$4.92	$8.41
Stocks Dec. 31: Consumer	721,714	1,107,215	717,466	540,756	596,757
World: Production [2]	8,192,000	8,330,000	r 8,808,000	r 8,296,000	8,556,000

r Revised.
[1] Includes bismuth, bismuth alloys, and waste and scrap.
[2] Excludes United States.

Legislation and Government Programs.—Bismuth held in Government stocks totaled 2,100,004 pounds. Of this total, the national stockpile held 585,892 pounds and the supplemental stockpile 1,514,112 pounds. The stockpile objective is 95,900 pounds, indicating a surplus of 2,004,104 pounds which requires Congressional action for public disposal.

Exploration assistance for bismuth continued under the Office of Minerals Exploration, and Government participation remained at 75% of the exploration costs.

Federal income tax laws under the Tax Reform Act of 1969 provided a percentage depletion allowance of 22% for domestic production and 14% for U.S. companies producing from foreign sources.

DOMESTIC PRODUCTION

Domestic output of bismuth was down 13%, as production by American Smelting and Refining Company (Asarco), Omaha, Nebr., the principal producer, continued to decline. Production was again almost entirely associated with refining of domestic and foreign lead ores and bullion. The remaining small quantity of bismuth was recovered from processing leady flue dusts obtained from copper converting processes.

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[1] Physical scientist, Division of Nonferrous Metals.

U.S. production is expected to increase significantly when The Anaconda Company's Victoria mine in Elko County, Nev., reaches full production. This is a copper mine and the bismuth content of the copper concentrate is estimated at about 0.7%. At this concentration of bismuth, an additional 400,000 pounds of bismuth could be supplied to the domestic market. UV Industries, Inc., produced no bismuth in 1974. A small quantity of metallic bismuth was obtained from secondary sources at Franklin Park, Ill., by United Refining and Smelting Co.

Domestic refinery production statistics are withheld to avoid disclosing individual company confidential data. Although domestic production is not included in tabulated world production, the United States usually ranks among the first six producing countries. The proportion of domestic production that comes from imported concentrates, bullion, and dusts can be estimated only roughly; it is probably no more than half.

CONSUMPTION AND USES

U.S. consumption of bismuth in 1974 was 2.28 million pounds, a 21% decrease in comparison with the previous year and the lowest recorded since 1971. Decreases occurred in all three major consuming categories with the most pronounced decrease in pharmaceuticals, which is composed of therapeutic agents, cosmetics, and chemical compounds. The requirements for bismuth in chemical compounds, mainly bismuth oxychloride, were down significantly, indicating possible substitution of cheaper material to obtain the pearlized or lustrous look in lipstick, eye shadows, and nail polish.

The use of bismuth as an alloy in metallurgical applications, to improve machinability of aluminum, steel, and malleable iron, dropped 19%. This was probably due to decreased production in the automobile industry.

Consumption of bismuth in fusible alloys was 20% below that of 1973, resulting from a slowdown in industrial activity and the record high selling price of bismuth during most of 1974.

New uses for bismuth were discussed by the Bismuth Institute at a meeting held in La Paz, Bolivia. An aluminum-bismuth alloy was used in doors and window frames where it retained its luster in spite of weathering effects. A process was patented in France that used bismuth to cure cattle and hogs affected with colitis.

Table 2.—Bismuth metal consumed in the United States, by use
(Pounds)

Use	1973	1974
Fusible alloys[1]	932,630	748,604
Metallurgical additives	830,928	668,982
Other alloys	15,206	21,417
Pharmaceuticals[2]	1,117,644	838,134
Experimental uses	21	305
Other uses	9,790	6,536
Total	2,906,219	2,283,978

[1] Includes bismuth contained in bismuth-lead bullion used directly in the production of an end product.

[2] Includes industrial and laboratory chemicals and cosmetics.

STOCKS

Consumer stocks of bismuth declined from 560,000 pounds at the end of the first quarter to a low of 546,000 pounds at the end of the second quarter, increased to 627,000 pounds by the end of the third quarter, and totaled 597,000 pounds at yearend. The U.S. Government sold only 57 pounds of bismuth during 1974, and Government stocks were 2,100,004 pounds at yearend.

PRICES

The producer price of refined bismuth fluctuated widely during 1974. The price was $6.50 per pound at the beginning of the year and reached a high of $12 per pound in midyear before declining to $9 per pound in August. The $9 per pound price remained in effect through yearend. Dealer prices were even more volatile, reaching a record high of $20.50 per pound before being gradually reduced.

The London Metal Exchange (LME) price for imported bismuth metal, c.i.f., was $6.50 per pound through January, but had increased to $14.00 to $14.25 by early April. After holding relatively steady through the spring months, the price began declining in June, leveling at $6.40 in late December.

FOREIGN TRADE

Exports of bismuth metal, alloys, waste, and scrap totaled 329,926 pounds, more than double those of 1973, and because of high prices the value of $1.5 million was nearly four times the 1973 figure. This was the highest export since 1970, when 910,275 pounds were shipped. Of the 24 countries that imported bismuth materials, the United Kingdom, the Netherlands, Belgium, Canada, and Austria, in declining order of receipts, accounted for about 80% of the total. Israel, Guyana, Mexico, and Argentina and 15 other small importers received the remainder.

General imports of metallic bismuth totaled 1,893,744 pounds, 29% below the 1973 level. The decline in imports was attributed to low demand resulting from record high 1974 prices. The decline of some 790,000 pounds in bismuth imports resulted from a substantial reduction in receipts from such principal suppliers as Japan, the United Kingdom, West Germany, Mexico, and Peru. Increased shipments from Bolivia, Canada, and the Republic of Korea failed to offset the decrease from the major sources. Metal imports from Australia began during the year and were expected to increase rapidly as the new Tennant Creek smelter becomes fully operational. The total value of imported bismuth metal was $15.6 million, an increase of 61% compared with that of 1973.

Table 3.—U.S. exports of bismuth [1]

Year	Gross weight (pounds)	Value
1971	71,187	$199,084
1972	264,276	492,585
1973	151,053	446,284
1974	329,926	1,520,105

[1] Includes bismuth, bismuth alloys, and waste and scrap.

Table 4.—U.S. general imports of metallic bismuth, by country

Country	1973		1974	
	Quantity (pounds)	Value (thousands)	Quantity (pounds)	Value (thousands)
Australia	--	--	1,873	$13
Belgium-Luxembourg	58,079	$241	43,270	307
Bolivia	1,410	4	90,501	727
Canada	73,932	345	89,892	947
Germany, West	343,686	1,627	222,043	1,799
Japan	754,146	1,255	337,115	3,005
Korea, Republic of	67,358	280	74,143	672
Mexico	357,796	1,341	292,544	1,971
Netherlands	2,517	19	22,114	207
Peru	[r] 496,151	[r] 2,145	459,204	3,757
South Africa, Republic of	29,994	85	--	--
United Kingdom	487,552	2,292	258,942	2,183
Yugoslavia	11,050	54	2,103	18
Total	[r] 2,683,671	[r] 9,688	1,893,744	15,606

[r] Revised.

In addition to imports of bismuth metal, bismuth is imported as bismuth alloys, bismuth lead alloys, and bismuth compounds. Bismuth alloys with 169,000 pounds of bismuth content were received from Mexico, Canada, and the United Kingdom. Bismuth compounds totaling 42,400 pounds gross weight were received from Belgium-Luxembourg, France, Mexico, Canada, Spain, and West Germany.

WORLD REVIEW

The most significant development in the world bismuth industry was the shift from oversupply at the beginning of 1974, to a market with increasing prices and shortages in the United States by midyear, followed by a return to a supply-demand balance by yearend. Factors contributing to this unstable condition ranged from Japan's inability to obtain raw material from Australia to drastically reduced output at times by the major producers.

Also of importance was the third meeting of the Bismuth Institute held in La Paz, Bolivia, in February 1974. The Institute was formed in 1973 for the purpose of studying and promoting uses for bismuth. The information center is located in Brussels, Belgium.

Table 5.—Bismuth: World mine production, by country

(Thousand pounds)

Country [1]	1972	1973	1974 [p]
Argentina (in ore)	[e] 1	--	--
Australia (in concentrates)	[r] 799	930	936
Bolivia [2]	[r] 1,298	1,423	[e] 1,430
Canada (in ore)	275	71	36
China, People's Republic of (in ore) [e]	550	550	550
France (metal)	148	[e] 155	[e] 155
Germany, West (in ore) [e]	27	25	28
Japan (metal)	1,974	1,900	1,837
Korea, Republic of (metal)	212	220	[e] 220
Mexico [3]	1,387	1,290	[e] 1,320
Peru [3]	[r] 1,598	1,262	1,470
Romania (in ore) [e]	180	180	180
Spain (metal)	[r] 6	[r] [e] 7	[e] 7
Sweden (in ore) [e]	33	33	33
Uganda (in ore)	9	[e] 9	[e] 9
U.S.S.R. (metal) [e]	120	120	180
United States	W	W	W
Yugoslavia	196	121	220
Total	8,808	8,296	8,556

[e] Estimate. [p] Preliminary. [r] Revised. W Withheld to avoid disclosing individual company confidential data.

[1] In addition to the countries listed, Brazil, Bulgaria, East Germany, and the Territory of South-West Africa are believed to produce bismuth, but available information is inadequate for formulation of reliable estimates of output levels.

[2] Production by COMIBOL, plus exports and local sales by medium and small mines.

[3] Bismuth content of refined metal, bullion, and alloys produced indigenously, plus recoverable content of ores and concentrates exported for processing.

Australia.—Mine production of bismuth in Australia reached a record 936,000 pounds in 1974. Increased output from the Peko-Wallsend Ltd. operation in the Northern Territory (N.T.) more than compensated for a decline in production at Welfram Camp. Peko-Wallsend Ltd. produced some 900,000 pounds of bismuth from three mines (Juno, Peko, and Warrego) at Tennant Creek, N.T. The increase over 1973 production was due primarily to the recovery of bismuth from copper concentrates produced at the new Tennant Creek smelter. Previously, all concentrates produced at Tennant Creek were exported, but when the copper smelter began operating in late 1973 flue dusts containing bismuth were collected for processing to bismuth bullion in the reduction plant. The plant began operation in 1974, producing a bullion containing 90% bismuth. The bullion was cast into 1-ton units and exported for refining. Ore reserves at the Juno mine as of June 30, 1973, were estimated at 110,000 tons averaging 0.80% bismuth and 60 grams of gold per ton. Reserves at the Peko mine totaled 500,000 tons of ore containing 0.15% bismuth, 3.2% copper, and 4 grams of gold per ton. At the Warrego mine, ore reserves was assessed at 5 million tons averaging 0.30% bismuth, 3 grams of gold per ton, and 2.6% copper.

Bolivia.—Bismuth production in Bolivia increased slightly to 1.43 million pounds, compared with 1.42 million pounds in 1973. The Bolivian bismuth ore is usually associated with copper and tin ores. In some areas, however, the bismuth content of ore is as high as 40%, and ore is mined primarily for its bismuth content. Most of the ore was processed at the Telamayu smelter operated by Corporación Minera de Bolivia (COMIBOL). The rich bullion produced at the plant was exported to Europe for refining. There are plans for the plant to be expanded to include a refining section to produce 99.9% bismuth metal.

Canada.—Production of bismuth, as a byproduct of smelting certain lead and zinc ores, declined again in 1974. Curtailed production of molybdenum mined in the

Malartic district of Quebec and copper ores mined near Gaspé, also in Quebec, where bismuth was a byproduct, accounted for the sharp decline. Output from lead concentrates by Cominco, Ltd., at Trail, British Columbia, and by Brunswick Mining and Smelting Corp. Ltd. at Belledune, New Brunswick, also declined. Lead and lead-zinc concentrate produced by Brunswick Mining and Smelting at its mines near Bathurst, New Brunswick, were smelted, and bismuth was produced from lead bullion.

Mexico.—Asarco Mexicana, S.A., and Metallurgica Mexicana Peñoles, S.A., were Mexico's two bismuth-producing companies during 1974. Both companies showed a slight gain in production which resulted in an overall gain of some 30,000 pounds. About half of the production was refined domestically, the remainder was exported to the United States and the United Kingdom in the form of bullion.

Japan.—Again Japan led the world in bismuth production, but output of 1.84 million pounds was down from the 1.90 million pounds produced in 1973. Japan produced a small quantity of bismuth from domestic ores, but most of the metal produced came from copper concentrates imported from Australia. With the processing of the copper concentrate in Australia, Japan's bismuth production can be expected to continue the downward trend.

Peru.—Production in Peru was 1.47 million pounds, 16% above the 1973 level. All production of bismuth was as a byproduct of copper-lead ore processing. A major part of Peru's production was exported and consumed in the United States. The remainder plus some imported concentrate from Bolivia was refined by the Cerro Corp. at La Oroya.

Boron

By K. P. Wang [1]

U.S. production and consumption of boron materials declined slightly in 1974, the first time in more than a decade. Meanwhile, exports rose to the highest level in 5 years. Output was adversely affected by a long strike, and consumption did not gain ground because of the short supply. Demand pressures were great within the United States, particularly in the glass wool area for insulation purposes related to savings in energy. Most U.S. output had been in the form of sodium borates and boric acid. In recent years, commercial production of calcium borate—first colemanite and later also ulexite—was resumed on a small scale in California, the State which provides the entire domestic production of boron minerals.

Table 1.—Salient statistics on boron minerals and compounds in the United States
(Thousand short tons and thousand dollars)

	1970	1971	1972	1973	1974
Sold or used by producers:					
Quantity					
Gross weight	1,041	r 1,047	1,121	1,225	1,185
Boron oxide	562	568	607	664	619
Value	$86,827	$89,856	$95,882	$113,648	$128,306
Imports for consumption: [1]					
Quantity	27	7	20	18	21
Value	$831	$233	$626	$568	$852

r Revised.
[1] Colemanite only.

DOMESTIC PRODUCTION

Domestic production and sales of boron decreased somewhat in 1974, compared with those of 1973. As in past years, most of the output came from Kern County, Calif., and to a lesser extent from San Bernardino County, Calif.

At Boron in Kern County, the large open pit mine belonging to U.S. Borax & Chemical Corp., a subsidiary of the British-owned Rio-Tinto Zinc Corp. Ltd., remained the world's foremost source of boron. U.S. Borax produced nearly pure crude sodium borates, refined sodium borates (including anhydrous borax), and boric acid (including anhydrous boric acid) at the mine site. High-purity and specialty products were produced mainly at Wilmington, Calif., and secondarily at Burlington, Iowa. Wilmington was also the company's port of export. These plants, led by the one at Boron, had a combined annual capacity of more than 600,000 short tons of boric oxide (B_2O_3) equivalent (or about 200,000 tons of contained boron) in 1974. Crude sodium borates, known commercially as Rasorite 46 and Rasorite 65 (anhydrous variation), represented about one half of U.S. Borax's output in value and three-fifths in tonnage. U.S. Borax maintains a storage center at Botlek in the Netherlands from which borax and borates are shipped to other parts of Europe. The company's production declined only slightly during the year, despite a strike lasting for more than 4 months during which supervisory workers conducted all operations. It was found that previous production levels could be maintained with a considerably smaller work force. Late in 1974, U.S. Borax announced a program to raise output by about one-third in 3 or 4 years at a cost of $55 to $60 million.

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[1] Supervisory physical scientist, Division of Nonmetallic Minerals.

At Searles Lake, Kerr-McGee Corp. operated the Trona plant and Stauffer Chemical Co. operated the nearby Westend plant until October 1 when Kerr-McGee bought the Stauffer plant. The former is rated at about 100,000 tons of B_2O_3 annually, and the latter at 25,000 to 30,000 tons. Borates were produced along with other chemicals such as soda ash, sodium sulfate, potassium sulfate, potassium chloride, lithium carbonate, and bromine. Kerr-McGee did not intend to disturb normal operations of the two facilities until savings can be clearly identified. Meanwhile, the high cost of energy for the distillation processes adversely affected production to some extent. The company was making headway in building its new $100 million, 1.3-million-ton-per-year soda ash plant, but costs were running much higher than original estimates. The initial plan was not to produce borates while recovering soda ash. When the new plant is completed, the soda ash part of the old plant may be scrapped, the borate part kept intact, and the salt cake part expanded.

During 1974, Tenneco Oil Co.'s Ryan mine near Death Valley, Calif., came into full operation. More reserves of colemanite were found, together with a new commercial product, ulexite. The colemanite was still shipped 30-odd miles to a plant near Lathrop Wells, Nev., where efficiency of calcining operations was greatly improved. The original designed capacity of the plant was about 70,000 tons of 48% B_2O_3-grade calcined colemanite annually, but production has been much lower, particularly in the first 2 years. The ulexite was trucked 100 miles to Dunn, Calif., where it was ground and upgraded to about a 26% to 28% B_2O_3-grade product for sale to insulating glass manufacturers. Colemanite went mainly to the tire and textile markets. The discovery of ulexite in commercial quantities expanded Tenneco's borate business.

CONSUMPTION AND USES

U.S. consumption of boron materials is difficult to estimate, because of the wide range of products and large tonnage of exports in the form of both crude and finished borates. Exports of finished borates are recorded in official U.S. trade statistics, but exports of crude borates are not. Both U.S. Borax and Kerr-McGee export considerable quantities of borates. These have to be deducted from the overall supply to evaluate what remains for consumption. Generally speaking, about half of the U.S. output of boron minerals and compounds was consumed at home, and the other half was exported. Measured in boron content (boron content of B_2O_3 is 31.1%), U.S. consumption was about 86,000 tons in 1969, 114,000 tons in 1973, and possibly 110,000 tons in 1974.

Average annual U.S. consumption of boron compounds during the last 5 years has been roughly 100,000 tons of boron content. About 40,000 to 45,000 tons goes into the manufacture of all kinds of glasses. Boron materials account for 5% to 10% of many special glasses by weight, and 50% to 75% by value. Approximately 15,000 tons per year goes into insulating fiberglass which has been gaining sharply as a consumer of boron. Roughly 10,000 tons of boron per year goes into the manufacture of enamels, frits, and glasses for protective and decorative coatings on sinks, stoves, refrigerators, and other household and industrial appliances.

Average annual U.S. consumption of boron compounds in soaps and cleansers has been about 15,000 tons of boron content including 5,000 tons in sodium perborate detergents used in high-temperature washing. Borax and boric acid uses in the cleansing field include toothpaste, mouthwash, eyewash, etc. Approximately 5,000 tons of boron yearly goes into agriculture as plant nutrients, and 2,000 to 3,000 tons goes into herbicides.

The list of miscellaneous uses has been growing: Borates as fluxing materials in welding, soldering, and metal refining; boron compounds in abrasives, especially boron nitride; boric acid as catalyst in air oxidation of hydrocarbons; boron as deoxidizer in nonferrous metallurgy, grain refiner in aluminum, thermal neutron absorber in atomic reactors, ignitor in radio tubes, and coating materials in solar batteries; direct consumption in chemicals; and boron materials for conditioning agents, plasticizers, latex paints, fire retardants, antifreeze, textiles, paper products, jet fuels, photography, and composites.

PRICES [2]

Prices for most borate products went up four times during 1974, and the two leading companies, U.S. Borax and Kerr-McGee, quoted different prices at different times. Prices went up more steeply for anhydrous products than for hydrated products, because of the high energy cost to remove water. The steep increases make it advisable to compare borate prices at the beginning and the end of the year. The rounded dollar figures quoted in table 2 are for U.S. Borax's bulk f.o.b. plant prices per short ton of product.

Table 2.—Borate prices per short ton, 1974

	Jan. 1	Dec. 31
Anhydrous borax	$110	$203
Refined pentahydrate borax	80	98
Refined decahydrate borax	60	81
Boric acid	184	199

FOREIGN TRADE

U.S. exports of boric acid were 35,740 tons valued at $8.8 million in 1974, compared with 41,407 tons in 1973. Exports of refined sodium borate, however, showed a sharp increase—to 218,107 tons valued at $33.8 million in 1974 from 168,826 tons in 1973. Thus, despite shortages at home, overall exports were higher during the year. As noted, these figures hardly tell the whole story since exports of crude borates were of the same magnitude as these of refined borates and boric acid combined.

A detailed breakdown of the recorded exports in 1974 is shown in table 3. Within this table, data for all countries outside Western Europe are fairly accurate. For Western Europe, the Netherlands is a major transshipment point rather than the final destination. A more meaningful array of recipient nations, including an estimate for crude borates, would show that West Germany, France, the United Kingdom, Japan, Belgium, Spain, and Italy were ahead of the Netherlands in that order.

In 1974, the United States imported 21,214 short tons of calcium borate (colemanite) valued at $852,000, all from Turkey. This compared with 18,216 short tons during 1973.

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[2] Chemical Marketing Reporter. Borax Prices Are Uneven As Market Continues Tight. V. 206, No. 2, Jan. 17, 1975, p. 17.

Table 3.—U.S. exports of boric acid and sodium borates, in 1974

Destination	Boric acid (H_3BO_3 content)		Sodium borates (refined)	
	Quantity (short tons)	Value (thousands)	Quantity (short tons)	Value (thousands)
Australia	2,633	$691	7,756	$1,177
Bangladesh	8	2	71	7
Belgium-Luxembourg	--	--	482	80
Brazil	1,778	513	1,598	297
Canada	3,118	669	28,286	3,725
Chile	17	6	--	--
Colombia	414	112	706	109
Costa Rica	14	4	337	55
Dominican Republic	4	3	52	6
El Salvador	53	51	134	40
Finland	--	--	385	59
France	76	23	2,494	476
Germany, West	2,912	686	1,522	281
Guatemala	2	1	36	6
Hong Kong	189	51	5,238	705
Indonesia	--	--	539	71

Table 3.—U.S. exports of boric acid and sodium borates, in 1974—Continued

Destination	Boric acid (H_3BO_3 content)		Sodium borates (refined)	
	Quantity (short tons)	Value (thousands)	Quantity (short tons)	Value (thousands)
Iran	--	--	383	$98
Israel	--	--	500	64
Italy	29	$3	--	--
Japan	12,716	3,081	43,115	7,083
Korea, Republic of	283	75	1,890	199
Lebanon	3	2	55	7
Malaysia	27	18	2	2
Mexico	2,778	540	15,036	2,188
Mozambique	--	--	224	119
Netherlands	4,114	838	59,411	9,884
New Guinea	120	32	75	11
New Zealand	614	145	4,005	861
Nicaragua	22	14	33	8
Peru	22	7	186	25
Philippines	341	87	820	136
Poland	523	118	--	--
Singapore	164	43	493	80
South Africa, Republic of	438	124	1,529	269
Sudan	--	--	280	152
Sweden	150	44	51	5
Switzerland	195	26	1,018	178
Taiwan	507	135	4,490	595
Thailand	90	27	701	125
United Kingdom	1,013	512	25,778	4,050
Venezuela	117	36	1,038	173
Vietnam, South	88	20	2,987	295
Yugoslavia	16	4	86	16
Other	152	31	393	124
Total	35,740	8,774	214,165	33,836

WORLD REVIEW[3]

Argentina.—Borate mineralization is widespread in the northwestern part of Argentina (also northern Peru), where there are desert basins called "lagunas" or "salares" having both sodium and calcium borates. The only important producer is Boroquimica Limitada, a subsidiary of Rio-Tinto Zinc Corp., which mines a Tertiary deposit in the Salas del Hombre Muerto basin. The ore from their Tincalayu mine (13,000 feet above sea level) is shipped 250 miles to the processing plant at Campo Quijano in the foothills of the Andes. Recent production has been about 50,000 to 60,000 tons of borates annually.

Turkey.—Turkey's output of borates has always been difficult to estimate, because of the varied products made and the interrelationship of the Government company Etibank and other producers. Reported statistics are generally inconclusive. As an order of magnitude, the country's 1974 production might have been approximately 250,000 tons of B_2O_3. The trend toward nationalization has brought Etibank increasingly towards the forefront, and it is this organization that is primarily engaged in the construction of new mine and plant facilities. Türks Boraks Madençilik A.S., a subsidiary of Rio-Tinto Zinc Corp., has already been relegated to a secondary position.

Extensive deposits of both tincal and colemanite are under Etibank's jurisdiction. Although details on 1974 output data are not available, Etibank's exports in 1974 consisted of about 255,000 tons of upgraded colemanite (about 40% B_2O_3 grade), 50,000 tons of upgraded tincal (perhaps 35% B_2O_3 grade), 17,000 tons of borax, and 10,000 tons of boric acid. Tincal was used to manufacture borax and boric acid at the Bandirma plant built around 1968. In addition to Etibank, six private companies together exported some 340,000 tons of colemanite in 1974.

Etibank operated two colemanite mines during 1974, the Emet open pit mine and the Espey underground mine, both in Kütahya Province and approximately 215 miles from the port city of Bandirma. A colemanite washing plant at Hisarcik with an annual capacity of just above 300,000 short tons of upgraded product (40% to 45% grade) went through its first year of full-scale operations during 1974.

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[3] Industrial Minerals (London). Borate Supplies Still Tight Despite Rising Capacity. No. 79, April 1974, pp. 11-29.

Etibank's tincal deposits at Kirka seem to rival those at Boron in California. The grade of run-of-mine ore is about 26% B_2O_3, with traces of arsenic. A washing plant with an annual capacity of more than 400,000 tons of product (35% B_2O_3 grade) was completed in the fall of 1974. Construction of a corresponding-size downstream facility was underway and scheduled for completion by 1976. The goal is to produce 200,000 tons of Rasorite 46 (crude pentahydrate borax), 55,000 tons of Rasorite 65 (crude anhydrous borax), and 10,000 tons of refined anhydrous borax. These developments indicate that Turkey's world position as a borate supplier will be further strengthened in the future.

U.S.S.R.—The U.S.S.R. may be producing about a third of a million tons of borates annually, about one-fourth of the U.S. level. Reserves there may be of the same order of magnitude as those in the United States, although probably not as high grade. The borate industry of the U.S.S.R. has had about four decades of history, with the first discoveries made along a fracture zone of a large Permian salt dome in the Inder district north of the Caspian Sea. Subsequently, other deposits were found in Kazakhstan, the Caucasus, and several places in Siberia, including Lake Baikal. Judging from Japanese purchases of 50,000 to 60,000 tons of Soviet borates, the U.S.S.R. has had some surplus for export. This strengthens the belief that domestic consumption there is relatively low.

TECHNOLOGY

It is reported that cutting tools coated with nickel-boron alloys last 10 times longer than nickel-phosphorus-coated tools, and 3 times longer than tools coated with hard chromium.[4]

Recently, boron fluoride complexes have found widespread application as catalysts and curing agents for epoxy resin, in preparing alcohol-soluble phenolic resins, and as catalysts for coatings and laminates, for cyclization of natural rubber, and for polymerization.

Significant progress has been made in the field of boron-reinforced composites, such as boron-epoxy, boron-aluminum, boron-magnesium, and other boron composites.[5]

A new nuclear reaction, described as a fundamental departure from conventional concepts of fission and fusion that produces virtually no lingering radioactivity, has been reported by the University of California's Lawrence Livermore Laboratory. This reaction involves the proton fissioning of boron–11, with the release of copious energy that could form the basis for eventual "super clean" powerplants.[6]

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[4] Metal Progress. Nickel-Boron Coatings Extend Tool Life. V. 103, No. 6, June 1973, p. 90.

[5] Materials Engineering. Boron Reinforced Composites. V. 79, No. 1, October 1974, pp. 16–18.

[6] Chemical Engineering. Dec. 10, 1973, p. 71.

Bromine

By Charles L. Klingman[1]

Toward the end of 1974, demand for bromine apparently exceeded supply, despite a modest increase in production. Two companies announced plans for expanding bromine capacity. Meanwhile, prices were increased to offset the higher costs of fuel and labor. There was a significant drop in use of ethylene dibromide, a gasoline additive. By contrast, consumption in the unclassified category ("Other compounds") rose substantially. This was probably caused by large increases in the output of new flame-retardant chemicals, although exact figures regarding these proprietary compounds were not available.

The first year for installing catalytic converters on certain new automobiles was 1974. It was quite difficult to use "leaded" gasoline, which necessarily contained ethylene dibromide, in these new cars. In addition, gasoline prices were up and consumption was down, so the net result was less ethylene dibromide used in gasoline. However, future requirements for ethylene dibromide are difficult to predict because of changing standards of the Environmental Protection Agency (EPA).

Table 1.—Elemental bromine sold as such or used in the preparation of bromine compounds by primary producers in the United States

(Thousand pounds and thousand dollars)

	1973		1974	
	Quantity	Value	Quantity	Value
Sold	39,203	7,350	45,760	12,177
Used	379,047	59,781	386,334	105,538
Total	418,250	67,181	432,094	117,715

Table 2.—Bromine compounds sold by primary producers in the United States

(Thousand pounds and thousand dollars)

	1973			1974		
	Quantity			Quantity		
	Gross weight	Bromine content	Value	Gross weight	Bromine content	Value
Ethylene dibromide	333,953	284,013	51,684	295,070	252,664	66,560
Methyl bromide	21,846	18,366	7,560	20,048	17,472	9,396
Other compounds[1]	98,606	68,471	60,444	157,166	112,510	106,186
Total	454,405	370,850	119,688	472,284	382,646	182,142

[1] Includes hydrobromic acid, tetrabromobisphenol, ethyl, ammonium, sodium, potassium, and other bromides.

DOMESTIC PRODUCTION

The value of elemental bromine sold as such in 1974 plus the value of bromine compounds sold totaled $194.3 million, an increase of $67.3 million or 53% over the corresponding data for 1973. The substantial rise in value was due primarily to increases in price for all bromine compounds.

Overall production of bromine in 1974 increased 3.3% over that of 1973, as shown in table 1. This increase may be compared with an average annual growth rate of 6.7% over the past 14 years, and with increases of 8.7% and 8.1% in 1972 and 1973, respectively.

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[1] Physical scientist, Division of Nonmetallic Minerals.

Arkansas production increased 7.9%, whereas Michigan and California registered declines. Arkansas produced 76% of U.S. bromine.

Approximately 10.6% of the bromine produced was sold in elemental form to nonmanufacturers of bromine compounds. There was an apparent loss of about 1% bromine when comparing the bromine used (going into compounds) with that found in the compounds after manufacture. This type of loss has averaged 1.35% over the past 5 years.

In 1974, there were 10 bromine-producing plants operated in 3 States by 7 companies. Two of these plants produced elemental bromine only, and one each produced ethylene dibromide, methyl bromide, and inorganic bromides. The remaining five plants produced a variety of compounds and elemental bromine. Two plants in Texas made compounds from purchased bromine and hence were not primary producers. Three bromine companies provided a combined total of 82% of U.S. output.

Ethyl Corp. which originally owned 80% of the Bromet Co. of Magnolia, Ark., purchased the remaining 20% of the company from Great Lakes Chemical Corp. in 1974. The name of the plant was changed from Bromet to Ethyl Corp.

Great Lakes Chemical Corp. of El Dorado, Ark., announced the construction of a new elemental bromine plant designed for additional production of 50 million pounds per year. Expenditures on the plant were estimated at $16 to $20 million.[2]

The Dow Chemical Co. also announced plans to increase bromine output at Magnolia, Ark. Expenditures will exceed $12 million.[3] Dow Chemical had a prolonged strike at its Midland, Mich., plant, but production was continued by supervisory and clerical personnel.

Table 3 lists the current bromine producers of the United States. U.S. resources are vast, although their full potential is unknown. If the rich brine sources should fail, there are unlimited reserves of dilute bromine in the oceans.

Table 3.—Bromine-producing plants in the United States

State and company	County	Plant	Production source
Arkansas:			
Arkansas Chemicals, Inc	Union	El Dorado	Well brines.
Ethyl Corp	Columbia	Magnolia	Do.
The Dow Chemical Co	do	do	Do.
The Great Lakes Chemical Corp	Union	El Dorado	Do.
Michigan Chemical Corp	do	do	Do.
California:			
Kerr-McGee Chemical Corporation	San Bernardino	Trona	Searles Lake brines.
Michigan:			
The Dow Chemical Co	Mason	Ludington	Well brines.
do	Midland	Midland	Do.
Michigan Chemical Corp	Gratiot	St. Louis	Do.
Morton Chemical Co	Manistee	Manistee	Do.

CONSUMPTION AND USES

The Bureau of Mines does not conduct a consumption survey of bromine and its compounds, but useful data may be derived from the production survey. The 1974 survey showed declines in the production of ethylene dibromide and methyl bromide, but a large gain in the unclassified category ("Other compounds").

Ethylene dibromide output dropped about 12% compared with a previous annual growth rate or 5.5% through 1973. The portion of the crude bromine production going into the manufacture of ethylene dibromide dropped to 58.5%. Three major factors probably contributed to this decline: (1) The general shortage of gasoline and the sharply increased price in 1974 restricted gasoline consumption, regardless of the additives used; (2) Many automobiles with catalytic converters were so constructed that it became quite inconvenient to use "leaded" gasoline (containing ethylene dibromide); and (3) there was a 5%–7% actual reduction by refiners in the concentration of additives used in gasoline. None of these factors reflected voluntary restriction by customers in the use of gasoline additives to reduce air pollution.

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[2] European Chemical News. Great Lakes Boosts U.S. Bromine Production. V. 26, No. 655, Sept. 27, 1974, p. 22.

[3] Chemical Engineering. CPI News Briefs. V. 82, No. 1, Jan. 6, 1975, p. 136.

In December 1974, a Federal court ruled against the EPA schedule for reduction of tetraethyl lead in gasoline; EPA has appealed the ruling. In early March 1975, the director of EPA imposed a 1-year delay in the enforcement of auto exhaust standards and said that catalytic converters were causing more harm than good. The entire situation of additives in gasoline and its potential effect on the bromine industry was in a state of turmoil, and future developments are uncertain.

Methyl bromide, used primarily as an agricultural chemical, showed reductions of 12% and 8% in the past 2 years compared with a previous growth rate of about 8% per annum.

Several 1-pound cans of methyl bromide shipped by the Great Lakes Chemical Corp. of El Dorado, Ark., were found to have defective caps and were recalled from the market. The chemical is normally used as a soil sterilant and could be fatal to human beings in high concentrations.[4]

The reduced production of ethylene dibromide and methyl bromide was more than offset by a 59% increase in production of other bromine compounds. The identity of the other bromine products must be concealed to avoid revealing proprietary information, but included a variety of flame-retardant chemicals. The use of flame-retardant chemicals has shown a 7% per year growth rate that may increase to 15% per year in the next 5 years.[5]

Elemental bromine has been used as a disinfectant, algaecide, and as an oxidizer. These markets seemed to be quite stable.

PRICES

The average unit price of bulk elemental bromine, as reported by producers in 1974, was 27.24 cents per pound, an increase of 70% over the average 1973 price. This was a sharp reversal in the historic trend toward lower bromine prices.

The price of bromine in drums was increased to 62 cents per pound in November 1974.[6]

Prices quoted in the Chemical Marketing Reporter as of December 30, 1974, for bromine and some of its compounds are shown in the following tabulation:

	Value per pound (cents)
Bromine; purified	
Carlots, truckloads, delivered	**75**
Drums, carlots, truckloads, delivered east of Rocky Mountains	**55–62**
Zone I:[1] Bulk tank car, tank trucks (45,000-pound minimum), delivered	**25–30**
Ammonium bromide, national formulary (N.F.), granular, drums, carlots, truckload, freight equalized	**48.0–48.5**
Bromochloromethane, drums, carlots, freight equalized	**54.5**
Tanks, same basis	**58**
Ethyl bromide, technical, 98%, drums, carlots, freight allowed, East	**68**
Ethylene dibromide, drums, carlots, freight equalized	**25**
Methyl bromide, distilled, tanks, 140,000-pound minimum, freight allowed	**34**
Potassium bromate, granular, powdered, 200-pound drums, carlots, freight allowed	**64–77**
Potassium bromide, N.F., granular, drums, carlots	**43.5**
Sodium bromide, N.F., granular, 400-pound drums, freight equalized	**40**

[1] Delivered prices for drums and bulk shipped west of Rockies, 1 cent per pound higher. Bulk truck prices 1 cent per pound higher for 30,000-pound minimum and 2 cents per pound higher for 15,000-pound minimum. Price f.o.b. Midland and Ludington, Mich., freight equalized, 1 cent per pound lower.

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[4] Chemical Marketing Reporter. Great Lakes Recalls Cans of Bug Killers Because Some Leak. V. 207, No. 10, Mar. 10, 1975, p. 4.

[5] Chemical Age. Flame Retardant Sales To Double by 1978. V. 110, No. 2904, Mar. 14, 1975, p. 2.

[6] Chemical Marketing Reporter. Bromine Makers Raise Tags. V. 206, No. 20, Nov. 11, 1974, p. 27.

FOREIGN TRADE

There was an apparent improvement in response to the 1974 Bureau of Mines survey on the exportation of bromine and its compounds. The fraction of production reported as exported rose from 9.9% in 1973 to 16% in 1974. Of the 69,346,000 pounds reported to be exported in 1974, 918,000 pounds was elemental bromine and 68,427,000 pounds was bromine contained in compounds.

Imports of bromine and its compounds remained nominal.

WORLD REVIEW

Bromine production outside the United States was about 212,000,000 pounds in 1974 compared with 432,094,000 pounds produced in the United States.

Bromine production from the United Kingdom was obtained through the Institute of Geological Sciences, London. The bromine compounds plant of Associated Octel, Ltd., in the Hale district of Manchester was closed in 1974.[7]

Israel is rapidly becoming a major producer of bromine. Bromine production there tripled in 7 years to an estimated 39.7 million pounds in 1974. Future plans call for a 50% increase in 1975, an additional 26% in 1976, and production up to 110 million pounds by 1979.[8] A company to produce bromine compounds at Be'er Sheva was founded in 1960. Its output was restricted for ecological reasons, but a new plant for compounds is to be built at Ramat Hovav, 8 miles south of Be'er Sheva. This company planned to produce 26.5 million pounds per year of compounds by 1976. The raw material for this new bromine production was the water of the Dead Sea, which contains 10,000 to 12,000 parts per million of bromine. The magnesium bromide content of the Dead Sea was estimated at 1,000 million tons.

Table 4.—Bromine: World production, by country

(Thousand pounds)

Country[1]	1972	1973	1974
France	29,895	[e] 31,000	[e] 31,000
Germany, West	6,000	[r] 6,400	7,500
India	[e] 550	[e] 550	[e] 600
Israel	[r] 31,085	[r] 28,748	39,700
Italy	[r] 9,965	[e] 11,500	[e] 11,000
Japan	23,093	[e] 24,300	[e] 25,100
Spain	[e] 880	[e] 880	[e] 1,000
United Kingdom	[r] 67,020	[r] 67,461	[e] 68,300
U.S.S.R	[e] 28,000	[e] 28,000	[e] 28,000
Total	[e] 196,488	[e] 198,839	[e] 212,200
United States	386,864	[r] 418,250	432,094
Grand total	[e] 583,352	[e] 617,089	[e] 644,294

[e] Estimate. [r] Revised.

[1] In addition to the countries listed, other nations may also produce bromine, but a reliable basis for estimation does not exist.

TECHNOLOGY

A 1974 energy survey by the Bureau of Mines revealed that approximately 5.08 kilowatt-hours or 17,300 Btu were required to produce a pound of bromine. This figure included only the direct fuel and power utilized by the wells and plants, and not the energy in the chlorine utilized nor the transportation necessary to move the bromine to its point of consumption.

Testing by the Chrysler Corp. indicated that ethylene dibromide, rather than tetraethyl lead, caused poisoning of the noble metal catalysts on automoble exhaust systems, but personnel of General Motors laboratories disagreed.[9]

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[7] European Chemical News. Israel's Inorganic Expansion. V. 27, No. 683, Apr. 18, 1975, p. 32.

[8] European Chemical News. Israel Embarks on Inorganics Development Plan. V. 27, No. 683, Apr. 18, 1975, pp. 30, 32, 35–36.

Chemical Age. Dead Sea Bromine Looks a Lively Prospect. V. 110, No. 2898, Jan. 31, 1975, pp. 16–17.

[9] Chemical Engineering. Chemtator. V. 81, No. 11, May 27, 1974, pp. 51–52.

Cadmium

By Ronald J. DeFilippo [1]

The trend in recent years of declining domestic production of cadmium metal continued, with output attaining its lowest level since 1946. Imported cadmium metal, not including cadmium contained in imported flue dust and zinc concentrates, provided 26% of the total U.S. supply, compared with 25% in 1973. General Services Administration (GSA) sales contributed 13% of the total U.S. cadmium metal supply. Imports of cadmium metal supplied 33% of the 1974 apparent consumption, 2% more than 1973.

Eight plants and seven companies accounted for the total domestic primary production. Canada was the major source of imported metal and ore concentrates. Producer prices increased from $3.75 to $4.25 per pound during the year.

Legislation and Government Programs.—Sales from the national stockpile (administered by GSA) were 1,006 tons in 1974. At yearend, the total stockpile inventory was 3,248 tons including 26 tons already committed. The objective for retention remained at 2,223 tons, and the quantity available for public disposal was 223 tons. Under the authority of Public Law 91–314 of July 10, 1970, a bill, S.3961, was introduced in the Congress on September 4, 1974, authorizing disposal of an additional 777 tons of cadmium from the strategic stockpile, but no further action was taken by yearend.

Exploration assistance for cadmium was offered by the Office of Minerals Exploration with 50% of allowable costs furnished by Government participation. However, no contracts were sought or active in 1974. Depletion allowances were 22% for domestic mines and 14% for mines in foreign countries.

Table 1.—Salient cadmium statistics
(Short tons)

	1970	1971	1972	1973	1974
United States:					
Production [1]	4,732	3,965	4,145	r 3,751	3,333
Shipments by producers [2]	3,424	3,887	5,240	4,304	3,250
Value ... thousands	$24,163	$9,823	$18,965	$23,891	$21,405
Exports	187	33	509	153	31
Imports for consumption, metal	1,246	1,749	1,211	r 1,948	1,985
Apparent consumption	4,531	5,436	6,313	r 6,267	6,050
Price: Average per pound [3]	$3.57	$1.92	$2.56	$3.64	$4.09
World: Production	18,227	17,007	r 18,371	r 18,884	18,780

r Revised.

[1] Primary and secondary cadmium metal. Includes equivalent metal content of cadmium sponge used directly in production of compounds.

[2] Includes metal consumed at producer plants.

[3] Average quoted price for cadmium sticks and balls in lots of 1 to 5 tons.

DOMESTIC PRODUCTION

The pace of domestic cadmium metal production slackened during the year, dropping from 958 tons during the first quarter to 685 tons during the fourth quarter. Cadmium metal production for the entire year, 3,333 tons, was down 11% from that of 1973. Metal production exceeded shipments by about 3% for 1974 and metal producer stocks increased accordingly from

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[1] Physical scientist, Division of Nonferrous Metals.

336 tons at the end of the first quarter to 698 tons at the end of the fourth quarter. The value of shipments decreased by about 10% from those of 1973, while the tonnage of shipments decreased by 24%. The smaller reduction in value was due to price increases throughout 1974.

Cadmium sulfide production (including cadmium sulfoselenide and cadmium lithopone) decreased 23% from that of 1973 and was the lowest level since 1970. The last quarter of 1974 saw the phaseout of cadmium production at the Amax, Inc., plant at Blackwell, Okla. The Blackwell plant had ceased zinc production at the end of 1973, but had continued to produce cadmium from residue stocks throughout 1974. By 1975, Amax was to have transferred all its cadmium production to its Sauget, Ill., facility.

Smelter recovery of cadmium in the United States averaged about 12.5 pounds per ton of slab zinc produced compared with about 6 pounds per ton for the rest of the world. Preliminary assays of zinc ores encountered in the development of The New Jersey Zinc Co.'s new Elmwood zinc mine in central Tennessee indicated about 0.4% cadmium, a relatively high value.

Cadmium oxide was produced by two of the eight primary metal producing plants. One plant reported secondary production, which was remelted metal or refined cadmium sponge.

Table 2.—Cadmium sulfide [1] produced in the United States
(Short tons)

Year	Sulfide [2] (cadmium content)
1970	1,068
1971	1,118
1972	1,357
1973	1,412
1974	1,085

[1] Cadmium oxide withheld to avoid disclosing individual company confidential data.
[2] Includes cadmium lithopone and cadmium sulfoselenide.

CONSUMPTION AND USES

The apparent consumption of cadmium, 6,050 tons, fell by 3% from that of 1973. Government sales contributed 17% of the total U.S. cadmium metal apparent consumption.

Metal used for electroplating hardware in land vehicles, marine uses, aircraft, and stationary mechanical and electrical equipment accounted for slightly less than half of the total U.S. cadmium consumption. Cadmium compounds used as pigments (red, orange, yellow) in paints and plastics and stabilizer compounds used in polyvinyl chloride accounted for about one-third of the total U.S. consumption. The remainder of U.S. consumption was accounted for by cadmium metal and compounds used in alloys, nickel-cadmium batteries, and specialized electronic devices.

Table 3.—Apparent consumption of cadmium
(Short tons)

	1973	1974
Stocks—beginning	1,662	1,326
Production	[r] 3,751	3,333
Imports, metal	[r] 1,948	1,985
Government sales	385	1,006
Total (supply)	[r] 7,746	7,650
Exports	153	31
Stocks—end	1,326	1,569
Total apparent consumption [1]	[r] 6,267	6,050

[r] Revised.
[1] Total supply minus exports and yearend stocks.

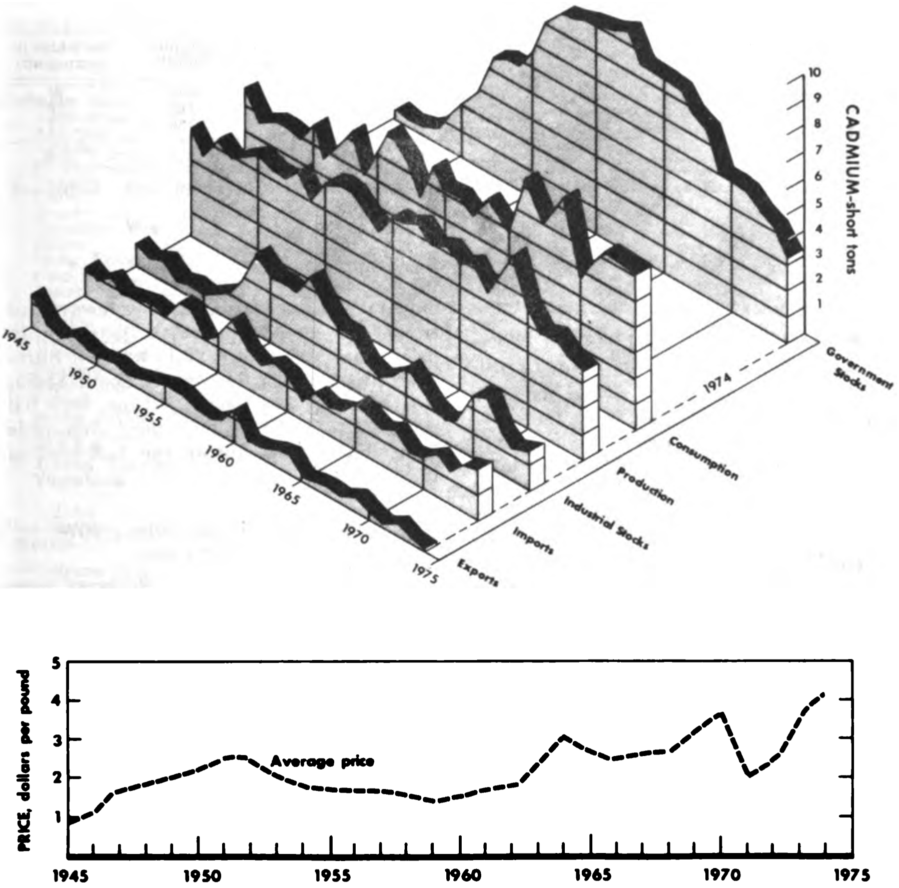

Figure 1.—Trends in production, consumption, yearend stocks, exports, imports, and average price of cadmium metal in the United States.

STOCKS

Stocks held by industry at the end of 1974 increased 18% to 1,569 tons reflecting the softening market for cadmium. Cadmium remaining in the GSA stockpile was 3,248 tons.

Table 4.—Industry stocks, December 31
(Short tons)

	1973		1974	
	Cadmium metal	Cadmium in compounds	Cadmium metal	Cadmium in compounds
Metal producers	456	W	698	W
Compound manufacturers	205	542	165	529
Distributors	104	19	136	41
Total	765	561	999	570

W Withheld to avoid disclosing individual company confidential data; included with "Compound manufacturers."

PRICES

The producer price for cadmium at the beginning of the year was $3.75 per pound for 1-ton lots. On May 1, one primary producer, National Zinc Co., raised its price to $4.30 per pound. A week later, the other cadmium producers raised their prices to $4.25. Dual pricing remained in effect until December 27, when National Zinc dropped its price to $4.25; cadmium was uniformly quoted at this price by all producers by yearend. Dealer quotes were slightly below producer prices, but by the end of March, some users were reportedly paying as much as $3.90 to $4.25 per pound. With the May producer price increase, dealer prices were once again in the producer price range but dropped to as low as $4 per pound in September and continued on a downward trend throughout the fourth quarter with prices varying between $2.15 and $4. European prices began the year at about $3.65, rose to about $4.60 by late June, then fell to $2.85 to $2.15 by December after wide price fluctuations during the last half of the year.

Table 5.—Cadmium prices, 1974
(Dollars per pound)

Date	Producers' price, 1-ton to 5-ton lots
Jan. 1 to May 1	3.75
May 1 to May 7	3.75–4.30
May 7 to Dec. 27	4.25–4.30
Dec. 27 to Dec. 31	4.25

FOREIGN TRADE

Exports of cadmium metal and scrap decreased from 153 tons in 1973 to 31 tons in 1974, the lowest level since 1940, the first year export data were published in the Minerals Yearbook. Principal destinations were as follows: Canada, 28%; Switzerland, 21%; Italy, 18%; Philippines, 6%; and other countries, 27%.

Canada was again the main source of primary cadmium metal imports, accounting for 33% of the total imports followed by Australia 19%, Belgium-Luxembourg 13%, Mexico 12%, Peru 7%, and other countries 16%.

Zinc concentrate imports for consumption from which cadmium was extracted were up 13% from the 1973 level. Taking into account all imported cadmium contained in flue dust, concentrates, and cadmium metal, total imported material increased 10% from 1973 levels.

No duties were imposed on metal or flue dust imported from most favored nations, but a statutory duty of 15 cents per pound was imposed on cadmium metal from countries with centrally controlled economies, except Yugoslavia.

Table 6.—U.S. exports of cadmium metal and cadmium in alloys, dross, flue dust, residues, and scrap

Year	Quantity (short tons)	Value (thousands)
1972	509	$2,363
1973	153	598
1974	31	238

Table 7.—U.S. imports for consumption[1] of cadmium metal and cadmium flue dust, by country

Country	1973		1974	
	Quantity (short tons)	Value (thousands)	Quantity (short tons)	Value (thousands)
Cadmium metal:				
Argentina	4	$24	--	--
Australia	359	2,395	385	$2,953
Austria	--	--	7	51
Belgium-Luxembourg	336	2,143	249	1,818
Canada	805	5,553	647	4,775
Chile	3	19	--	--
France	23	130	6	42
Germany, West	61	351	39	275
Ghana	6	25	--	--
Hong Kong	--	--	(2)	2
Italy	11	65	--	--
Japan	^{r}22	^{r}275	15	104
Korea, Republic of	24	162	60	450
Mexico	83	439	239	1,883
Netherlands	44	288	14	106
New Zealand	--	--	7	63
Panama	--	--	18	32
Peru	103	698	142	1,057
Poland	--	--	47	274
South Africa, Republic of	24	159	11	88
Spain	17	104	16	100
U.S.S.R	--	--	11	68
United Kingdom	6	35	14	116
Yugoslavia	17	98	58	417
Total	^{r}1,948	^{r}12,963	1,985	14,674
Flue dust (cadmium content):				
Mexico	^{r}174	^{r}611	166	603
Grand total	^{r}2,122	^{r}13,574	2,151	15,277

^{r} Revised.

[1] General imports and imports for consumption were the same in 1973 and 1974.

[2] Less than ½ unit.

WORLD REVIEW

World smelter production of cadmium was 1% below that of 1973. Japan and the United States were the largest metal producers, with 18% each of the total, followed by the U.S.S.R. 16%, West Germany 9%, Canada 8%, Belgium 6%, and other countries 25%. Apparent consumption in the United States was 32% of the world production.

International cadmium production underwent several developments. Met-Mex Peñoles, S.A., started up its zinc smelter in Torreón, Mexico, and Akita Zinc Co. Ltd. started up a new zinc smelter at Iijima, Japan. Both smelters will have cadmium plants. Cinko Kursum Metal Sanyii A.S. of Zamanti, Turkey, announced the development of a zinc and lead refining complex that will have a capacity of about 155 tons per year of cadmium, thereby adding Turkey to the list of cadmium producers. A smelter complex underway in India, operated by Hindustan Zinc Ltd., will increase that country's cadmium smelter capacity by 110 tons per year.

Table 8.—Cadmium: World smelter production, by country

(Short tons)

Country [1]	1972	1973	1974 [p]
North America:			
Canada (refined)	[r] 1,126	1,543	[e] 1,440
United States [2]	4,145	3,751	3,333
Latin America:			
Mexico (refined)	205	201	[e] 200
Peru	231	252	[e] 265
Europe:			
Austria	29	32	[e] 35
Belgium	[r] 1,243	1,264	[e] 1,150
Bulgaria [e]	220	220	220
Finland	193	197	[e] 200
France	631	668	[e] 650
Germany, East [e]	17	17	17
Germany, West	1,007	1,346	[e] 1,640
Italy	459	438	[e] 485
Norway	134	34	[e] 40
Netherlands	96	97	[e] 100
Poland [e]	390	390	390
Romania [e]	90	90	90
Spain	122	150	[e] 150
U.S.S.R. [e]	2,700	2,750	2,920
United Kingdom	265	346	308
Yugoslavia [e]	150	165	260
Africa:			
South-West Africa [3]	[r] 173	114	126
Zaire	326	306	[e] 330
Zambia	17	18	[e] 20
Asia:			
China, People's Republic of [e]	110	110	120
India	[r] 39	36	[e] 35
Japan	3,339	3,482	3,336
Korea, North [e]	120	120	120
Oceania: Australia	[r] 794	747	[e] 800
Total	[r] 18,371	18,884	18,780

[e] Estimate. [p] Preliminary. [r] Revised.

[1] Table gives unwrought metal production from ores, concentrates, flue dusts, and other materials of both domestic and imported origin. Sources generally do not indicate if secondary metal (recovery from scrap) is included or not; where known, this has been indicated by footnote. Data derived in part from World Metal Statistics (published by World Bureau of Metal Statistics, London) and from Metal Statistics (published by Metallgesellschaft Aktiengesellschaft, Frankfurt am Main). Cadmium is produced in ores, concentrates, and/or flue dusts in a number of other countries, but these materials are exported for treatment elsewhere to recover cadmium metal, therefore such output is not recorded in this table to avoid double counting.

[2] Includes secondary.

[3] Output of Tsumeb Corp. for calender years.

TECHNOLOGY

During 1974, there was continued interest in cadmium dispersal in the environment. A study of the spatial and temporal distribution of cadmium in the waters and bottom sediments of Corpus Christi Bay estuary was conducted. It was discovered that water entering the harbor was contaminated by metal-rich bottom sediments. The cadmium in the water would then be adsorbed by suspended particulate matter and thereby be distributed by the normal circulation of the bay. Similar research was being carried out in the United Kingdom.[2]

An excellent summary was prepared on the production, use, and distribution of cadmium in Canada, with some environmental considerations.[3]

The industrial sources of cadmium contamination and its effect on the environment was the subject of a brief summary. A summary of the state of the art in wastewater treatment for cadmium and other heavy metals was given.[4]

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[2] Gardiner, J. The Chemistry of Cadmium in Natural Water–II. The Absorption of Cadmium on River Muds and Naturally Occurring Solids. U.K. Dept. Environment. Water Res., v. 8, No. 3, March 1974, pp. 157–159.

Holmes, C. W., E. A. Slade, and C. J. McLerran. Migration and Redistribution of Zinc and Cadmium in Marine Estuarine System. Environmental Sci. & Technol., v. 8, No. 3, March 1974, pp. 255–259.

[3] Lymburner, D. M. The Production, Use, and Distribution of Cadmium in Canada. Environmental Contaminants Inventory Study No. 2. Canada Centre for Inland Waters, Inland Waters Directorate, Burlington, Ontario, 1974, 71 pp.

[4] Cadman, T. W., and R. W. Dillinger. Techniques for Removing Metal From Process Wastewater. Chem. Eng., v. 81, No. 8, Apr. 15, 1974, pp. 79–85.

Cox, D. B. Cadmium—A Trace Element in Mining and Manufacturing. J. Environmental Health, v. 36, No. 4, February 1974, pp. 361–365.

The Environmental Protection Agency (EPA) reported that approximately 500 tons of cadmium are lost annually in sludge from the domestic electroplating industry.[5]

In the health field, research was conducted into the interaction of cadmium and other toxic materials with nutritionally important substances such as zinc.[6]

A comprehensive study of the world economics of cadmium was made in which trade, consumption, end use, smelter, and mine production of various countries were discussed.[7]

Two methods of winning cadmium values from precipitates and solutions resulting from the leaching of roasted zinc concentrates were awarded patents, and another patent was awarded for a method of cadmium recovery in the Imperial smelting process.[8]

Hydrogen embrittlement during cadmium electroplating continued to be a subject for study where plated parts requiring a high reliability are involved. A cadmium-titanium alloy that can be electrodeposited and that is not subject to hydrogen embrittlement was developed and studied.[9]

Bell Laboratories, Inc., continued its research to develop efficient yet low cost cadmium sulfide-containing photovoltaic cells. Cadmium sulfide was studied for use in masers, and in green-light-emitting diodes. In other electronic applications, cadmium telluride was found to be an excellent detector material for gamma ray and electron spectroscopy. A cadmium compound was investigated as an ingredient in photochromic glasses.[10]

The origins of a cadmium-containing stratiform lead-zinc sulfide deposit in Michigan were studied.[11]

Developments in cadmium technology are frequently abstracted in Zinc Abstracts, a bimonthly publication available from The Zinc Institute, Inc., 292 Madison Avenue, New York, N.Y. 10017.

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[5] U.S. Environmental Protection Agency, Office of Solid Waste Management Programs. Report to Congress: Disposal of Hazardous Wastes. Publication SW-115, 1974, p. 49.

[6] Shakman, R. A. Nutritional Influences on the Toxin of Environmental Pollutants. Arch. Environmental Health, v. 28, No. 2, February 1974, pp. 105–113.

[7] Roskill Reports on Metals and Minerals. The Economics of Cadmium. Roskill Information Services Ltd., London, SWIP 3RZ, 2d ed., 1974, 209 pp.

[8] Brenatt, F. G. S., and M. W. Gamman (assigned to IGS Smelting Ltd.). Condensation of Zinc or Cadmium Vapor From the Blast Furnace Smelting Zinc Ore. Brit. Pat. 1,359,677, July 10, 1974.

Fugleberg, S. P., (assigned to OutoKumpu Oy, OutoKumpu, Finland). Process for Producing Cadmium. U.S. Pat. 3,850,619, Nov. 26, 1974.

Martini, P., G. Scacciati, and A. Vaschetti (assigned to Montedison S.p.A. Milan, Italy). Apparatus for Continuous Cementation of Metals from Solutions by Means of Metal Granules, Mine Water, Etc. U.S. Pat. 3,806,103, Apr. 23, 1974.

[9] Altura, D. Postplating Embrittlement. Metal Finishing, v. 72, No. 9, September 1974, pp. 45–66.

Kim, D. H., and D. G. Clark. Diffussivity of Hydrogen in Electrodeposited Cadmium-Titanium Alloy. Corrosion, v. 30, No. 7, July 1974. pp. 242–247.

Parthasaradany, N. V. Hydrogen Embrittlement During Electrodeposition of Metals and Related Processes, a Review. Plating, v. 61, No. 1, January 1974, pp. 57–61.

[10] Mailing, G. S. Photochromism in Cadmium Borosilicate Glasses. Phys. Chem. Glasses, v. 14, No. 6, December 1973, pp. 118–121.

Triboulet, R., Y. Marfaing. Undoped High Resistivity Cadmium Telluride for Nuclear Radiation Detectors. J. Appl. Phys., v. 45, No. 6, June 1947, pp. 2759–2765.

Vrba, J. and R. R. Haering. Voltage Modulation of CdS Phonon Masers. J. Appl. Phys., v. 44, December 1973 pp. 5213–5218.

Wagner, S. Preparation and Properties of Green-Light-Emitting CdS–$CuGaS_2$ Heterodiodes. J. Appl. Phys., v. 45, January 1974, pp. 246–251.

Wagner, S., J. L. Shay, P. Migliorato, and H. M. Kasper. $CuInSe_2$/CdS Heterojunction Photovoltaic Detectors. Appl. Phys. Letter, v. 25, Oct. 15, 1974, pp. 434–435.

[11] Brown, A.C. Epigenetic Origin of the Stratiform Cd–Pb–Zn Sulfides in the Lower None-Such Shale, White Pine, Mich. Econ. Geol., v. 69, March 1974, pp. 271–274.

Calcium and Calcium Compounds

By Avery H. Reed [1]

Calcium metal was manufactured by one company in Connecticut. Calcium chloride was produced by two companies in California and three companies in Michigan. Synthetic calcium chloride was manufactured by three companies in New York and Washington.

DOMESTIC PRODUCTION

Pfizer Inc., produced calcium metal at Canaan, Conn., by the Pidgeon process, in which quicklime and aluminum powder are heated in vacuum retorts; at a temperature of 1,170° C, calcium vaporizes and is collected at one end of the retort.

National Chloride Co. of America and Leslie Salt Co. produced calcium chloride from wells in San Bernardino County, Calif. Output declined 5%.

The Dow Chemical Co., Michigan Chemical Corp., and Wilkinson Chemical Corp. recovered calcium chloride from brine in Gratiot, Lapeer, Mason, and Midland Counties, Mich. Output increased 44%.

Total production of natural calcium chloride was a record high of 867,000 tons, 42% more than that of 1973 and 32% above the 1969 record high.

Allied Chemical Corp. recovered synthetic calcium chloride as a byproduct of soda ash at Syracuse, N.Y. Reichold Chemicals, Inc., recovered synthetic calcium chloride as a byproduct of pentachlorophenol manufacture at Tacoma, Wash., and Hooker Chemical Corp. manufactured calcium chloride at Tacoma using limestone and hydrochloric acid. Total output of synthetic calcium chloride decreased 6% to 234,000 tons, 44% below the 1968 record high.

The total value of all calcium chloride sold in 1974 was a record high of $36.1 million.

CONSUMPTION AND USES

Calcium metal was used as a reducing agent to separate metals such as columbium, tantalum, thorium, titanium, uranium, vanadium, and zirconium from their oxides; to form alloys with aluminum, lead, lithium, magnesium, and silicon; as a scavenger in the steel industry; and in the manufacture of calcium hydride. A potentially important use for calcium metal is in a new storage battery that requires no water to be added.

The principal use for calcium chloride was to melt snow and ice from roads, streets, bridges, and pavements. Calcium chloride is more effective at lower temperatures than rock salt, and is mainly used in the Northern and Eastern States. It was also used to keep down dust on roads and driveways, and as an accelerator for concrete.

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[1] **Supervisory physical scientist, Division of Nonmetallic Minerals.**

PRICES AND SPECIFICATIONS

Prices for calcium metal ranged from \$1 to \$5 per pound. Calcium chloride is usually sold either as solid flake or pellet averaging about 75% $CaCl_2$, or as a concentrated liquid averaging about 40% $CaCl_2$. On a 75% basis, the average value in 1974 for natural calcium chloride was \$33.66 per ton; and the average value for synthetic calcium chloride was \$29.40 per ton.

FOREIGN TRADE

Exports of calcium chloride, mainly to Canada and Mexico, were 30,900 tons valued at \$1,699,000, compared with 96,900 tons valued at \$2,225,000 in 1973. Exports of dicalcium phosphate, mainly to Mexico, Malaysia, People's Republic of China, and Thailand, totaled 29,200 tons valued at \$6,864,000. Exports of precipitated calcium carbonate, mainly to Canada, Singapore, and South Vietnam, were 11,100 tons valued at \$1,541,000.

Total imports of calcium and calcium compounds were 239,000 tons valued at \$16,899,000. Imports of calcium metal from Canada, France, and the U.S.S.R. totaled 55 tons valued at \$121,000. Imports of calcium chloride, mainly from Canada, were 3,600 tons valued at \$156,000, 51% below those of 1973. Imports of other calcium compounds, mainly from Norway, Turkey, Italy, Canada, and the Netherlands, were 235,000 tons valued at \$16,623,000.

Imports of other calcium compounds included 155,244 tons of calcium nitrate from Norway, Italy, the Netherlands, Sweden, Denmark, Canada, and New Zealand; 34,181 tons of whiting from France, Switzerland, the United Kingdom, Belgium-Luxembourg, and Italy; 21,214 tons of calcium borate from Turkey; 6,515 tons of dicalcium phosphate from Israel, Canada, the Netherlands, and West Germany; 3,563 tons of calcium carbide from Canada and Belgium-Luxembourg; 3,345 tons of precipitated calcium carbonate from the United Kingdom, Japan, Brazil, France, the Netherlands, West Germany, and Canada; 3,127 tons of calcium cyanamide from West Germany, Canada, and Japan; 1,935 tons of calcium cyanide from Canada; and 5,972 tons of other compounds, mainly from the United Kingdom, the Netherlands, and West Germany.

Table 1.—U.S. imports for consumption of calcium and calcium chloride

Year	Calcium		Calcium chloride	
	Pounds	Value	Short tons	Value
1970	164,769	\$141,125	8,280	\$359,096
1971	48,391	29,751	13,019	543,656
1972	248,080	181,437	6,128	225,463
1973	110,407	77,864	7,357	317,007
1974	109,252	120,883	3,599	155,727

Table 2.—U.S. imports for consumption of calcium chloride, by country

Country	Quantity (short tons)	Value
Belgium-Luxembourg	22	\$1,642
Canada	3,327	132,370
France	22	1,529
Germany, West	187	16,194
Mexico	6	461
United Kingdom	35	3,531
Total	3,599	155,727

WORLD REVIEW

Canada.—Chromasco Corporation Limited produced calcium metal at its Haley smelter near Renfrew, Ontario. Canada continued to lead all other countries in the production of calcium metal. About 48 tons valued at $98,000 was exported to the United States. Canada was the leading source of U.S. imports of calcium chloride.

France.— Planet Wattohm S.A., a subsidiary of Compagnie de Mokta, produced calcium metal by the Pidgeon process. About 6 tons valued at $22,000 was exported to the United States.

U.S.S.R.—Some calcium metal was produced in the U.S.S.R. Nearly 1 ton of Soviet calcium metal valued at $1,100 was exported to the United States.

Carbon Black

By John L. Albright [1]

Demand for carbon black was strong during the first half of 1974 but fell during the second half of the year, owing mainly to reduced demand for automobile tires. Carbon black was utilized by numerous industries, but most of the production was used in transportation vehicle tires and related automobile industry rubber products. Producers encountered increased costs for natural gas and liquid hydrocarbon feedstocks and reported that carbon black prices failed to keep pace with spiraling costs. Texas produced more carbon black than any other State, and Louisiana maintained its position as the country's second largest producer. Furnace black production declined 2.7% from the 1973 output. Production of channel blacks continued its downward trend, and by yearend 1974 channel black production in the United States was restricted to one Cities Service Co. plant in Texas.

Shipments, including exports, of carbon black totaled 3,324 million pounds. Domestic shipments fell to 3,123 million pounds, after 3 consecutive years of increases. Total exports of channel and furnace blacks increased 9 million pounds, reaching nearly 202 million pounds by yearend. Imported carbon black totaled 29.6 million pounds and was supplied mainly by Canada, Indonesia, and West Germany. Small quantities of bone black were imported from Canada and West Europe, and some lampblack was imported from West Germany.

According to Chemical Marketing Reporter, channel black prices were stable during the year, but prices of most grades of furnace black increased 35% to 68%, reflecting mainly large increases in feedstock costs. Prices of thermal blacks recorded the largest increases.

Numerous grades of carbon black were shipped to ink, paint, rubber, and several other small industries, and the rubber industry continued to consume the largest quantities of carbon black. Most of the carbon black was used in the manufacture of highway vehicle tires and other automobile industry products. The 1974 slowdown in carbon black production and shipments mirrored the performance of the tire industry. According to the Rubber Manufacturers Association, Inc., 175.7 million motorcycle and passenger tires were produced in 1974 (a decrease of 7.1% from the previous year), and shipments of these tires fell 26.8 million units to 175.2 million units during 1974. Production of bus and truck tires increased 4.3% to 35.7 million units in 1974, although shipments of these tires fell 2.6 million units to 34.2 million units during 1974.

Carbon-black-producing plants operated at 78.98% of capacity during 1974, a significant decrease from the 82.85% of capacity in 1973. Plant capacity increased 1.6% from that of 1973. More than three-fourths of the capacity was in Louisiana and Texas.

During August, Continental Carbon Co. assumed the marketing of its carbon blacks and established its domestic sales headquarters in Akron, Ohio. Continental's carbon blacks had previously been marketed by Witco Chemical Corporation. Phillips Petroleum Co. established its worldwide carbon black marketing office in Akron during the year.

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[1] Mineral specialist, Division of Petroleum and Natural Gas.

Table 1.—Salient statistics of carbon black produced from liquid hydrocarbons and natural gas in the United States

(Thousand pounds)

	1970	1971	1972	1973	[1] 1974
Production:					
Channel process	113,548	46,354	22,378	14,222	W
Furnace process	2,817,605	2,970,781	3,178,731	3,485,719	3,390,325
Total	2,931,153	3,017,135	3,201,109	3,499,941	W
Shipments (including losses):					
Domestic	2,650,450	2,853,948	3,148,114	3,314,646	3,122,660
Exports	192,636	163,246	111,238	192,665	201,737
Total	2,843,086	3,017,194	3,259,352	3,507,311	3,324,397
Producer stocks Dec. 31	296,087	296,028	237,785	230,415	293,908
Value:					
Production thousand dollars	$222,271	$232,049	$248,361	$284,153	$372,281
Average per pound cents	7.58	7.69	7.76	8.12	10.98

W Withheld to avoid disclosing individual company confidential data.

[1] Excludes channel black.

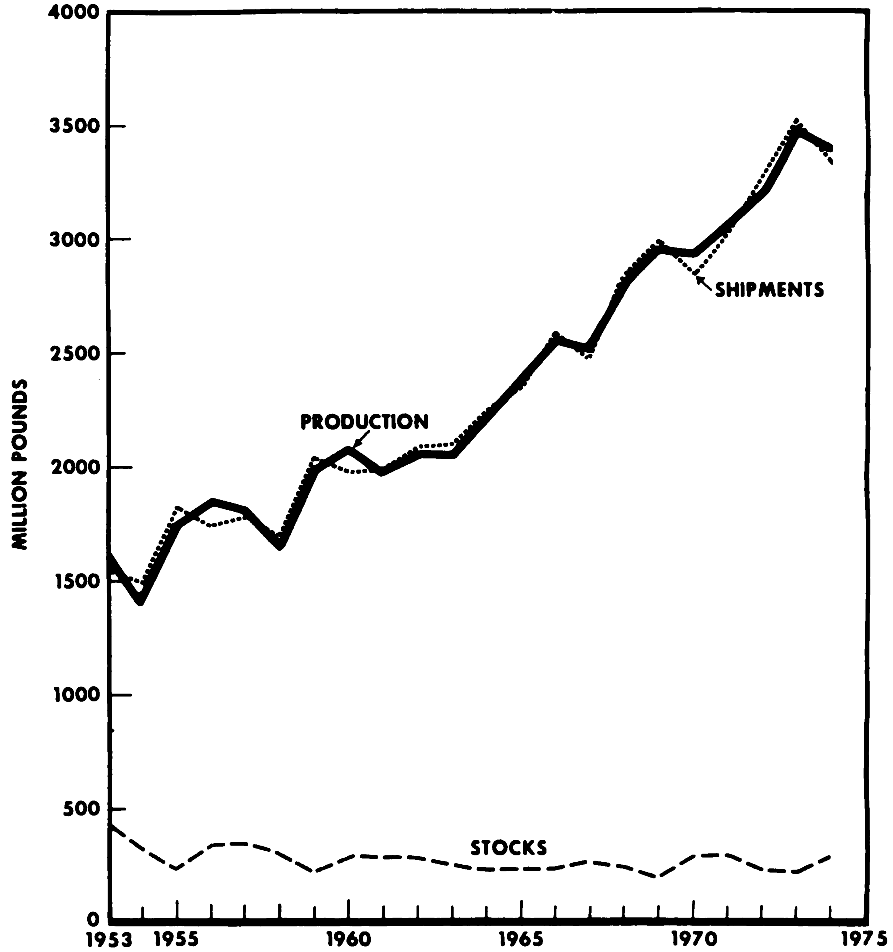

Figure 1.—Production, stocks, and shipments of carbon black.

PRODUCTION AND CAPACITY

Production by State.—Carbon black production totaled 3,390 million pounds of furnace black during 1974, plus an undisclosed amount of channel black; the industry produced a record 3,500 million pounds of channel and furnace blacks in 1973. Plants in Louisiana and Texas produced an aggregate of 2,628 million pounds of furnace black in 1974, or 77.5% of the national total, and the remaining output came from plants in Arkansas, California, Kansas, Ohio, Oklahoma, and West Virginia.

Production by Grade and Type.—All of the reported carbon black output was obtained by furnace combustion and thermal cracking methods, but small quantities of channel blacks were also produced during the year. Channel black production has fallen sharply during the past decade and dropped from 113.5 million pounds in 1970 to 14.2 million pounds in 1973. The combined production of Fast-Extrusion Furnace (FEF), General-Purpose Furnace (GPF), and High-Abrasion Furnace (HAF) grades accounted for nearly three-fourths of the 1974 furnace black production.

Number and Capacity of Plants.—Thirty-four carbon black plants operated in the United States in 1974, but during the year Cabot Corp. closed its Texas channel black plant and Continental Carbon Co. closed its Alabama furnace black plant. More than three-fourths of the installed plant capacity was in Louisiana and Texas. The total daily capacity of carbon black plants reached 11.8 million pounds in 1974, an increase of 16% from the previous year and 17.2% during the period 1969–74.

Cities Service Co. increased the capacity of its Franklin, La., plant and installed dual supply lines at the company's plants to permit boilers and dryers to be fueled by natural gas or oil. Cities Service continued to operate its Texas channel black plant, but reduced the number of specialty grades produced at the facility. J. M. Huber Corp. developed plans which will raise the firm's annual output capacity by 30 million pounds.

During 1974 Phillips Petroleum Co. had authorized, or under construction, carbon black production expansions at its Borger and Orange, Tex., and Toledo, Ohio plants. When completed, the new units will provide an additional 57 million pounds of annual capacity to the company's domestic output. After installing a computer at its Borger, Tex., plant to control output of several reactors, Phillips reported a higher degree of continuous quality control and economies in feedstocks used. The computer regulates the tangential gas input on the basis of caloric content rather than mass or volumetric flow and maintains a continuous heat balance around each reactor.

Materials Used and Yields.—In 1974, a total of 578.8 million gallons of liquid hydrocarbons was used in the manufacture of 3,209 million pounds of carbon black, after the industry had consumed a record 623.2 million gallons of liquid hydrocarbons in the previous year. Yields averaged 5.54 pounds per gallon from the liquid hydrocarbons, compared with 5.22 pounds per gallon in 1973. Natural gas feedstocks continued their downward trend, decreasing by 9,552 million cubic feet to 40,130 million cubic feet in 1974. The volume of carbon black produced from natural gas was 181 million pounds, a decline of 65.3 million pounds, or 26.5% from the 1973 production. Yields of carbon black from natural gas in 1974 averaged 4.51 pounds per thousand cubic feet, a decrease of 9.1% from that of 1973.

CONSUMPTION AND USES

The rubber industry used over 92% of the carbon black consumed. Tire manufacturers, the principal consumers, have found the commodity's remarkable ability to reinforce and strengthen rubber virtually indispensable to their industry. Automobile passenger tires used 6 or 7 pounds of carbon black each, and truck tires used approximately 20 pounds of blacks each. After 3 consecutive years of growth, domestic sales of carbon black fell 5.0% to 3,147 million pounds in 1974, due mainly to the recession which held down the production and sales of automobiles and tires. During 1974, sales to rubber manufacturers fell by 6.1%, while sales to paint and paper manufacturers decreased by 12.6% and 14.4%, respectively. Sales to the ink industry fell 1.4 million pounds to 83.0 million pounds during 1974.

STOCKS

Yearend 1974 furnace black stocks were 293.9 million pounds, an increase of 65.9 million pounds or 28.9% above the 1973 inventory. The 1974 yearend inventory was the industry's largest in 3 years. Channel black stocks were not reported by the industry during the year.

Significant increases in stocks were reported in thermal and FEF blacks, which were both at low levels in January. Stocks of most furnace grades increased slightly during the year. Inventories of HAF were maintained at the highest level of all grades of carbon black, and represented 36.9% of the total furnace black stocks at yearend.

FOREIGN TRADE

Exports of carbon black increased 9.1 million pounds to 201.7 million pounds in 1974. Furnace blacks accounted for 95.7% of the exports, and although channel blacks made up only 4.3% of the exports, they accounted for $6.1 million (18.4%) of the $32.9 million total value of the exported blacks. Average value of the channel blacks exported in 1974 was 69.2 cents per pound (49.9 cents per pound in 1973), and that of furnace blacks was 13.9 cents per pound (9.3 cents per pound in 1973). Nearly 68% of the carbon black exports went to Asia and Europe, with Japan and France purchasing the largest quantities.

Carbon blacks imported into the United States during 1974 totaled 29.6 million pounds, an increase of 19.9 million pounds from 1973 imports. During 1974, the volume of imported blacks from Indonesia rose 32.7%, and imports from Canada increased 414%. In 1974, imported carbon blacks were valued at an average 14.6 cents per pound, compared with 16.3 cents for exported carbon blacks; the corresponding 1973 values were 11.4 and 12.5 cents per pound, respectively.

In 1974, West Germany shipped 25,000 pounds of lampblack valued at $4,500 to the United States, and 91,354 pounds of bone black valued at $13,000 was imported from Belgium-Luxembourg, Canada, and West Germany.

WORLD REVIEW

The United States, Japan, and West Germany were the three largest manufacturers of carbon black, accounting for more than one-half of the known world production. Worldwide demand for carbon black was strong in 1974, and significant expansions to producing plants were authorized or under way in numerous countries.

In an effort to meet the demand for carbon black in Australia, a subsidiary of Phillips Petroleum Co. approved plans to enlarge the capacity of the Kurnell carbon black plant by 6.6 million pounds per year.

During 1974 motor vehicle production increased significantly in Brazil, and several tire manufacturing facilities and a carbon black plant were being enlarged to meet increasing demand. A subsidiary of Firestone Tire and Rubber Co. expanded tire manufacturing facilities at Rio de Janeiro and São Paulo, and a Goodyear Tire and Rubber Co. subsidiary planned to double the capacity of the Americana tire plant near São Paulo. Companhia Petroquimica Brasileira—with major interests held by Cities Service Co. —increased the capacity of the São Paulo carbon black plant to 130 million pounds per year. The Cabot Corp., International Finance Corp., and União de Industrias Petroquimicas, S.A. were planning to construct a carbon black plant at Capuava, also near São Paulo.

Commercial production began at the Cancarb Ltd. thermal black plant in Medicine Hat, Alberta, Canada, and the firm studied plans to increase the output of the facility in the near future. Approximately one-half of the Cancarb thermal black was marketed in Canada and the United States, and the balance was shipped to Australia, Japan, Latin America, and Western Europe. The Bristol, England, carbon black plant, jointly owned by Cities Service Co. and Phillips Petroleum Co., added production units which boosted its annual capacity by 8.8 million pounds. India increased the annual capacity of the

Durgapur plant by 4.4 million pounds, an extension to the Ravenna, Italy, carbon black plant raised its annual production capacity by 11 million pounds, and additional production units were installed at the Port Elizabeth, Republic of South Africa, facility, raising the output capacity by 17.6 million pounds per year.

TECHNOLOGY

Carbon black, a petrochemical, is an extremely fine soot, primarily carbon (90% to 99%), that contains some hydrogen and oxygen. Oil furnace black may also contain small amounts of sulfur. Properties of carbon black are determined largely by the process by which it is manufactured. Furnace black, which accounts for 99% of all carbon black produced, is made by three different processes—gas furnace, oil furnace, and thermal. Brief descriptions follow of these processes, the channel process, and the manufacture of lampblack and acetylene black.

Gas Furnace.—The gas furnace process is based on partial combustion of natural gas in refractory-lined furnaces. Carbon black is removed by flocculation and high-voltage electric precipitators. Yields of the gas furnace blacks range from 10% to 30% and are the lowest for the smaller particle-size grades. Properties of gas furnace blacks can be modified to a degree by changing the ratio of air to gas. High-Modulus Furnace (HMF) and Semireinforcing Furnace (SRF) grades are generally produced from gas.

Oil Furnace.—Liquid hydrocarbons are used in the oil furnace process. Natural gas is generally burned to furnish the heat of combustion, and atomized oil is introduced into the combustion zone to be burned to various grades of carbon black. Yields range from 35% to 65%, depending on the grade of black produced. Oil furnace grades are FEF, GPF, HAF, Intermediate-Abrasion Furnace (ISAF), and Superabrasion Furnace (SAF).

The most desirable feedstock oil for furnace black plants has 0° to 4° API gravity, is low in sulfur, and is high in aromatics and olefins. It comes from near the "bottom of the refinery barrel" and is similar in many respects to residual fuel oil. Rising costs of natural gas have influenced the shift to a greater use of liquid feedstocks and a corresponding decline in the use of natural gas as a source of carbon. Oil furnace processing has become highly flexible, supplementing channel blacks in most high-performance applications, notably passenger car tires. Over the past 2 decades, carbon black technology has centered on the oil furnace black process.

Thermal.—Unlike channel and the gas and oil furnace blacks, thermal blacks are produced by cracking hydrocarbons, that is, by separating carbon from the hydrogen and not by the combustion of hydrocarbons. Thermal furnaces are built in a checkerboard brickwork pattern. Two refractory-lined furnaces, or generators, are used. One generator is heated using hydrogen as a fuel, while the other is charged with natural gas, which decomposes to produce thermal black and hydrogen. Hydrogen collected is used as fuel for the generator being heated. Yields of carbon black range from 40% to 50% and are primarily in the large particle sizes.

Channel Black.—Made by the oldest process, channel black is a product of incomplete combustion of natural gas. Small flames are impinged on cool surfaces, or channels, where carbon black is deposited and then scraped off as the channel moves back and forth over a scraper. Properties of channel black are varied by changes in burner tip design, distances from tip to channel, and the amount of air made available for combustion. The process is extraordinarily inefficient chemically. For rubber-reinforcing grades, the yield is only 5%; for high-color blacks of finer particle sizes, the yield shrinks to 1%. Low yields and rising gas prices have spurred the industry to develop other methods to make blacks.

Lampblack.—Lampblacks are manufactured by slowly burning selected oils and tars in a restricted supply of air. These blacks are of large particle size, possess little reinforcing ability in rubber, and are low in jetness and coloring power. They are of value as tinting pigments in certain paints and lacquers. In most applications lampblacks have been replaced by carbon blacks.

Acetylene Black.—Acetylene blacks, produced by the thermal decomposition of acetylene, possess a high structural, or chaining, tendency. They provide high elastic modulus and high conductivity in rubber stocks.

Coal-derived carbon blacks have yet to be produced commercially, but several small companies are marketing carbon black extenders and fillers which are produced from anthracite and bituminous coals. These carbon black substitutes are used in rubber compounding and in the production of carbon paper, ink, paint, and plastic. Extenders (fillers from coal) are being utilized in conjunction with furnace carbon blacks, replacing thermal blacks.

Table 2.—Carbon black produced from liquid hydrocarbons and natural gas in the United States, by State

(Thousand pounds)

	1970	1971	1972	1973	1974	Change from 1973 (percent)
Louisiana	982,416	1,078,732	1,077,977	1,207,708	1,192,795	-1.2
Texas	1,395,851	1,326,153	1,425,874	1,511,127	1,434,797	-5.1
Other States	552,886	612,250	697,258	781,106	762,733	-2.4
Total	2,931,153	3,017,135	3,201,109	3,499,941	3,390,325	-3.1

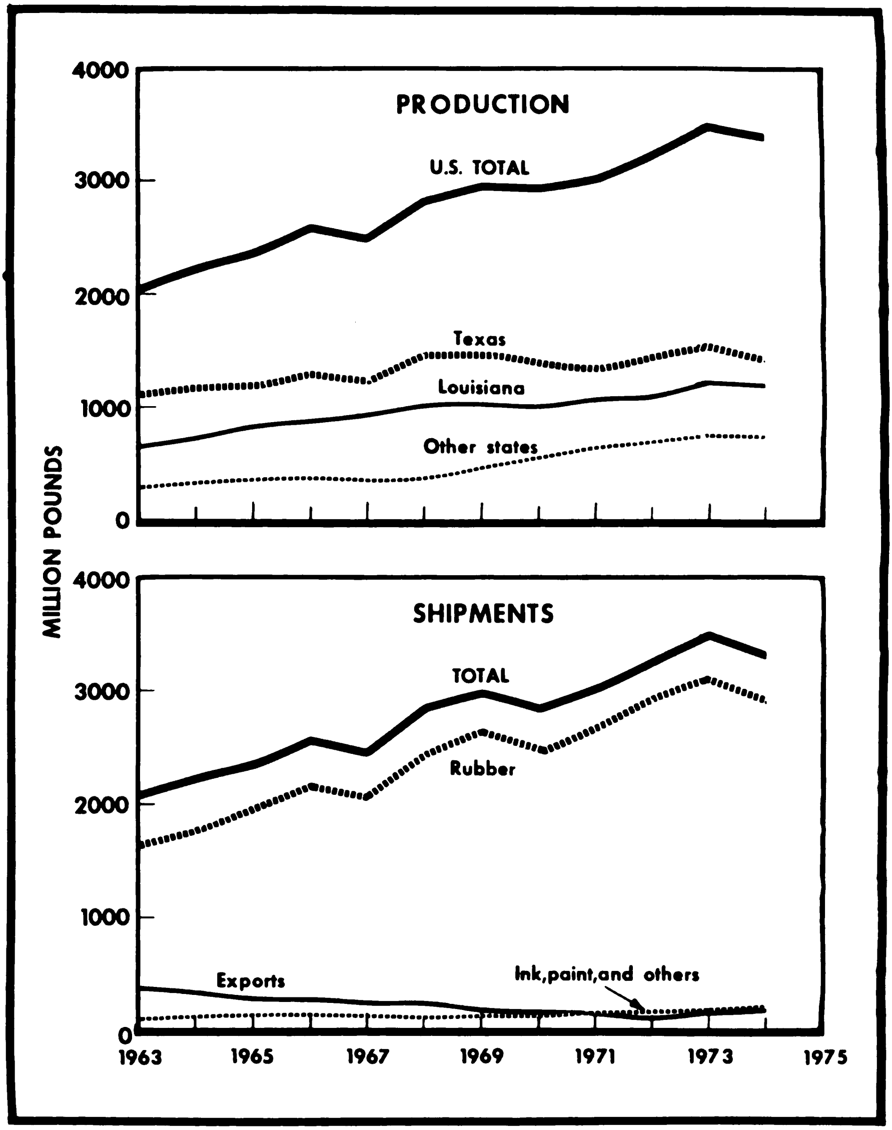

Figure 2.—Production by State; shipments by use, and exports of carbon black.

Table 3.—Production, shipments and stocks of carbon black in the United States in 1974 by grade
(Thousand pounds)

	SRF	GPF	FEF	HAF	SAF	ISAF	Thermal	Total [1]
Production	311,877	670,826	387,142	1,434,611	38,935	272,657	274,277	3,390,325
Shipments	309,981	672,994	372,201	1,418,194	35,651	265,935	249,441	3,324,397
Stocks:								
Dec. 31, 1974	29,111	39,948	34,600	108,480	8,835	32,308	40,621	293,903

[1] Excludes channel black to avoid disclosing individual company confidential data.

Table 4.—Number and capacity of carbon black plants operated in the United States

State	County or parish	Number of plants 1973 Channel	Number of plants 1973 Furnace	Number of plants 1974 Channel	Number of plants 1974 Furnace	Total daily capacity (pounds) 1973	Total daily capacity (pounds) 1974
Texas	Aransas	--	1	--	1	5,213,511	5,212,674
	Carson	1	--	1	--		
	Gaines	1	--	1	--		
	Gray	--	1	--	1		
	Harris	--	1	--	1		
	Howard	--	2	--	2		
	Hutchinson	--	2	--	2		
	Montgomery	--	1	--	1		
	Moore	--	1	--	1		
	Orange	--	1	--	1		
	Terry	--	1	--	1		
	Wheeler	--	1	--	1		
Total Texas		2	12	2	12	5,213,511	5,212,674
Louisiana	Avoyelles	--	1	--	1	3,851,837	3,962,467
	Calcasieu	--	1	--	1		
	Evangeline	--	1	--	1		
	Ouachita	--	2	--	2		
	St. Mary	--	3	--	3		
	West Baton Rouge	--	1	--	1		
Total Louisiana		--	9	--	9	3,851,837	3,962,467
Alabama	Russell	--	1	--	1	2,507,833	2,585,339
Arkansas	Union	--	1	--	1		
California	Kern	--	3	--	3		
Kansas	Grant	--	1	--	1		
Ohio	Lucas	--	1	--	1		
	Washington	--	1	--	1		
Oklahoma	Kay	--	1	--	1		
West Virginia	Pleasants	--	1	--	1		
	Marshall	--	1	--	1		
Total other States		--	11	--	11	2,507,833	2,585,339
Total United States		2	32	2	32	11,573,181	11,760,480

Table 5.—Carbon black and feedstock used in its production, by State

		Louisiana	Texas	Other States [1]	Total
1973					
Carbon black production:					
Total	thousand pounds	1,207,708	1,511,127	781,106	3,499,941
Value	thousand dollars	$96,824	$128,144	$59,185	$284,153
Average value	cents per pound	8.02	8.48	7.58	8.12
Natural gas used:					
Total	million cubic feet	21,278	23,142	5,262	49,682
Value	thousand dollars	$5,181	$5,236	$1,601	$12,018
Average value	cents per thousand cubic feet	24.35	22.63	30.43	24.19
Carbon black produced [2]	thousand pounds	182,107	42,878	21,438	246,423
Liquid hydrocarbons used:					
Total	thousand gallons	186,577	295,358	141,301	623,236
Value	thousand dollars	$16,149	$25,989	$14,158	$56,296
Average value	cents per gallon	8.66	8.80	10.02	9.03
Carbon black produced	thousand pounds	1,025,601	1,468,249	759,668	3,253,518
1974					
Carbon black production:					
Total	thousand pounds	1,192,795	1,434,797	762,733	3,390,325
Value	thousand dollars	$131,811	$155,603	$84,867	$372,281
Average value	cents per pounds	11.05	10.84	11.12	10.98
Natural gas used:					
Total	million cubic feet	23,668	11,781	4,681	40,130
Value	thousand dollars	$9,299	$4,466	$2,637	$16,402
Average value	cents per thousand cubic feet	39.29	37.91	56.34	40.87
Carbon black produced [2]	thousand pounds	141,344	22,736	17,059	181,139
Liquid hydrocarbons used:					
Total	thousand gallons	175,507	257,968	145,336	578,811
Value	thousand dollars	$14,614	$57,965	$35,622	$138,201
Average value	cents per gallon	25.42	22.47	24.51	23.87
Carbon black produced	thousand pounds	1,051,451	1,412,061	745,674	3,209,186

[1] Arkansas, California, Kansas, Ohio, Oklahoma, and West Virginia.
[2] Produced from natural gas used as feedstock.

Table 6.—Liquid hydrocarbons and natural gas used in manufacturing carbon black in the United States and average yield

	1970	1971	1972	1973	1974
Natural gas used ---------- million cubic feet --	85,884	63,699	53,939	49,682	40,130
Average yield of carbon black per thousand cubic feet ---------- pounds --	4.44	5.06	5.02	4.96	4.51
Average value of natural gas used per thousand cubic feet ---------- cents --	16.45	17.51	19.54	24.19	40.87
Liquid hydrocarbons used --- thousand gallons --	523,914	547,704	590,753	623,236	578,811
Average yield of carbon black per gallon pounds --	4.87	4.92	4.96	5.22	5.54
Average value of liquid hydrocarbons used per gallon ---------- cents --	7.35	7.96	8.13	9.03	23.87
Number of producers reporting ----------	9	9	8	8	8
Number of plants ----------	37	37	34	34	34

Table 7.—Sales of carbon black for domestic consumption in the United States, by use

(Thousand pounds)

Use	1970	1971	1972	1973	1974	Change from 1973 (percent)
Ink ----------	72,824	75,201	82,532	84,364	83,009	−1.6
Paint ----------	14,570	18,693	21,408	21,667	18,936	−12.6
Paper ----------	4,527	3,767	4,225	4,212	3,604	−14.4
Rubber ----------	2,486,146	2,678,151	2,953,779	3,114,565	2,925,032	−6.1
Miscellaneous [1] ----------	71,454	77,715	84,764	88,786	115,939	+30.6
Total ----------	2,649,521	2,853,527	3,146,708	3,313,594	3,146,520	−5.0

[1] Includes chemical, food, plastics, and metallurgical.

Table 8.—U.S. exports of carbon black, by country

(Thousand pounds and thousand dollars)

Country	1972		1973		1974	
	Quantity	Value	Quantity	Value	Quantity	Value
North America:						
Canada ----------	19,735	2,057	26,226	1,942	15,170	2,259
Guatemala ----------	148	17	1,549	161	1,333	159
Honduras ----------	--	--	83	11	100	20
Jamaica ----------	23	3	1,391	148	1,170	141
Mexico ----------	1,662	273	4,303	342	6,507	446
Other ----------	515	49	318	37	123	27
Total ----------	22,083	2,399	33,870	2,641	24,403	3,052
South America:						
Argentina ----------	1,425	248	1,553	198	1,077	198
Brazil ----------	3,553	385	24,074	2,178	17,417	2,182
Chile ----------	318	54	446	61	340	81
Colombia ----------	471	77	543	79	959	119
Peru ----------	250	29	276	40	263	61
Uruguay ----------	21	5	151	3	66	8
Venezuela ----------	809	97	670	74	651	101
Other ----------	34	4	37	18	57	9
Total ----------	6,881	899	27,750	2,651	20,830	2,759
Europe:						
Austria ----------	140	43	145	17	92	24
Belgium-Luxembourg ----------	2,931	278	1,900	242	5,014	724
Denmark ----------	954	180	596	125	772	253
Finland ----------	302	33	227	128	117	32
France ----------	13,815	1,558	14,444	1,661	23,255	3,733
Germany, West ----------	7,252	792	9,380	929	15,444	2,246
Hungary ----------	--	--	--	--	81	30
Italy ----------	4,212	552	4,142	735	5,892	1,503
Netherlands ----------	15,898	2,434	30,436	5,179	10,174	2,459
Norway ----------	433	42	281	27	265	37
Portugal ----------	278	43	500	63	172	33
Romania ----------	--	--	522	87	410	168
Spain ----------	1,961	261	2,741	347	5,188	1,029
Sweden ----------	192	24	433	34	480	99

Table 8.—U.S. exports of carbon black, by country—Continued

(Thousand pounds and thousand dollars)

Country	1972		1973		1974	
	Quantity	Value	Quantity	Value	Quantity	Value
Europe—Continued						
Switzerland	955	103	724	93	1,397	198
United Kingdom	5,535	904	9,411	1,335	10,746	2,239
Yugoslavia	148	42	328	75	418	81
Other	71	14	14	3	94	30
Total	55,077	7,303	76,229	11,080	80,011	14,918
Africa:						
Algeria	--	--	3	4	33	10
Angola	1	1	73	7	329	44
Ghana	940	115	2,262	244	2,337	349
Kenya	748	67	1,173	98	1,524	236
Morocco	34	3	29	3	42	8
South Africa, Republic of	4,431	424	5,148	624	8,945	1,049
Tanzania	51	6	350	35	1,332	246
Zambia	--	--	44	7	551	84
Other	21	4	60	13	35	5
Total	6,226	620	9,142	1,035	15,128	2,031
Asia:						
Cambodia	115	10	110	11	109	19
Hong Kong	202	34	371	58	253	60
India	1,988	233	619	97	572	135
Indonesia	195	16	252	28	1,242	176
Iran	91	15	55	15	73	16
Israel	468	51	431	59	477	61
Japan	7,996	2,117	13,706	3,165	23,452	4,577
Korea, Republic of	532	120	4,019	486	2,117	256
Lebanon	118	11	136	11	152	21
Malaysia	246	19	155	23	4,872	720
Pakistan	226	18	3,123	278	2,365	344
Philippines	625	59	1,211	139	1,206	124
Singapore	294	32	277	56	5,188	934
South Vietnam	1,071	93	1,340	160	3,809	517
Sri Lanka	10	2	--	--	224	36
Taiwan	748	159	14,110	1,381	6,699	851
Thailand	634	58	356	43	3,713	473
Turkey	100	14	164	34	186	40
Other	9	1	16	2	18	4
Total	15,668	3,062	40,451	6,046	56,727	9,364
Oceania:						
Australia	3,523	407	3,429	411	3,483	672
New Zealand	1,780	166	1,794	192	1,155	151
Total	5,303	573	5,223	603	4,638	823
Grand total	111,238	14,856	192,665	24,056	201,737	32,947

Table 9.—U.S. exports of carbon black in 1974, by month

(Thousand pounds and thousand dollars)

Month	Channel		Furnace		Total	
	Quantity	Value	Quantity	Value	Quantity	Value
January	1,028	473	21,256	2,220	22,284	2,693
February	1,015	567	19,579	2,076	20,594	2,643
March	443	238	24,955	2,605	25,398	2,843
April	1,604	812	29,310	3,392	30,914	4,204
May	941	413	25,326	3,401	26,267	3,814
June	542	600	15,470	2,133	16,012	2,733
July	549	431	14,073	2,258	14,622	2,689
August	794	465	11,773	3,137	12,567	3,602
September	645	806	11,379	1,959	12,024	2,765
October	217	376	8,275	1,518	8,492	1,894
November	567	490	8,013	1,373	8,580	1,863
December	422	400	3,561	804	3,983	1,204
Total	8,767	6,071	192,970	26,876	201,737	32,947

Table 10.—Carbon black: World production by country

(Million pounds)

Country [1]	1972	1973	1974 [p]
Argentina [e]	66	66	66
Australia [e]	128	131	156
Belgium [e]	4	4	4
Brazil	144	[e] 143	[e] 193
Canada [e]	196	258	249
Colombia [e]	45	50	55
Czechoslovakia [e]	[r] 66	[r] 66	66
France	350	[e] 353	[e] 346
Germany, West	582	641	661
Hungary [e]	9	10	10
India [e]	88	100	143
Indonesia [e]	3	3	6
Iran	--	--	4
Italy	288	324	[e] 335
Japan	751	891	830
Korea, Republic of	[r] 20	29	35
Mexico [e]	74	74	75
Netherlands	206	219	[e] 226
Romania	163	171	[e] 180
South Africa, Republic of	[e] 66	88	[e] 83
Spain	125	111	121
Sweden	52	[e] 54	[e] 62
Taiwan	([2])	([2])	([2])
United Kingdom	450	481	[e] 545
United States	3,201	3,500	3,390
Venezuela [e]	16	18	40
Yugoslavia	29	34	[e] 35
Total	[r] 7,122	7,819	7,916

[e] Estimate. [p] Preliminary. [r] Revised.

[1] In addition to the countries listed, the People's Republic of China, Norway, Poland, Turkey and the U.S.S.R. produce carbon black, but production is not reported, and available information is inadequate to make reliable estimates of output levels.

[2] Less than ½ unit.

Cement

By Brinton C. Brown [1]

Portland cement shipments from plants in the United States and Puerto Rico in 1974 totaled 79,482,000 tons, a decrease of 8% below the record 1973 shipments and the lowest since 1971. Despite curtailed output, profits and return on investment improved after price controls were removed in late 1973 by the Cost of Living Council. Mill value for portland cement rose to $2.1 billion, an increase of 11% over 1973, reflecting a unit value increase of $4.64 per ton.

The cement situation in the United States in 1974 was one of restricted demand, increased production capacity, and escalating production costs (caused mostly by inflation and rising fuel and power costs), but price increases were adequate to compensate for these increases.

In an effort to curb spiraling inflation, the Federal Reserve Board took restrictive action on the money supply that led to record high interest rates. As a result of the tight money market and high interest rates, a broad decline in most types of construction occurred, with a sharp downturn in housing construction.

Atlantic Cement Co., Inc. completed an air-quality-control project at its Ravena, N.Y. plant, and was cited in 1974 by the American Lung Association and by the New York Department of Environmental Conservation for achievements in air quality control.

Louisville Cement Co. led Portland Cement Association members competing for the 1974 Safety Contest Awards, with 9 consecutive years without a lost-time accident.

Table 1.—Salient cement statistics
(Thousand short tons and thousand dollars)

	1970	1971	1972	1973	1974
United States: [1]					
Production [2]	74,325	78,324	82,597	r 85,513	80,917
Shipments from mills [2 3]	74,607	80,396	83,336	r 88,665	81,033
Value [2 3 4]	$1,336,255	$1,528,056	$1,724,140	r 1,975,409	$2,150,659
Average value per ton [2 3 4]	$17.91	$19.01	$20.69	r $22.28	$26.54
Stocks Dec. 31 at mills [2]	7,574	6,425	7,036	r 5,512	7,467
Exports	123	84	83	268	199
Imports for consumption	2,473	3,057	4,851	r 6,647	5,702
Consumption, apparent [5 6]	75,882	81,498	84,952	r 90,679	82,862
World: Production	629,645	679,948	r 723,796	r 773,061	p 776,210

p Preliminary. r Revised.
[1] Excludes Puerto Rico.
[2] Includes portland and masonry cement only.
[3] Includes imported cement shipped by domestic producers only.
[4] Value received, f.o.b. mill, excluding cost of containers.
[5] Quantity shipped plus imports minus exports.
[6] Adjusted to eliminate duplication of imports (clinker and cement) shipped by domestic cement manufacturers.

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[1] Physical scientist, Division of Nonmetallic Minerals 1970–75. (Now with U.S. Geological Survey, Reston, Va.)

Legislation and Government Programs.—The Housing and Community Development Act of 1974 authorized $8.4 billion to fund over a 3-year period the development of low-income areas of cities, and help home buyers and home builders. In mid-October, the Emergency Home Purchase Assistance Act of 1974 was signed by the President, permitting the Federal Government to pump $7.75 billion into the mortgage market through the Government National Mortgage Association and the Federal Home Loan Mortgage Corp. to stimulate the housing industry. New occupational noise regulations were published on August 7, 1974, in the Federal Register by the Mine Enforcement and Safety Administration and became effective on that date.

On May 28, the Supreme Court denied a petition for certiorari in the case of the Portland Cement Association versus the Environmental Protection Agency (EPA). The U.S. Court of Appeals, District of Columbia Circuit, held that EPA was not required to issue an environmental impact statement in promulgating new source performance standards and that EPA did not have to justify its action in requiring stricter performance from one industry than from another. However, the Court of Appeals ruled that EPA failed to make available to the cement industry sufficient data with respect to test results and procedures upon which the standards were based, and ordered EPA to do so.

The Texas Parks and Wildlife Department ordered Parker Brothers & Co., Inc. one of the major shell dredging firms in the Gulf of Mexico, to cease operation on one tract in the San Antonio Bay because the operation was causing siltation. As a result of the shutdown, two cement plants in the Houston, Tex., area had an immediate 50% reduction in shell feedstocks. Texas shell dredgers may face further problems because the Bay Fishermen and Rockport Conservation Association, Inc., is objecting to renewal of all dredging permits that expired December 31, 1974.

In August EPA gave notice of an air pollution violation to the Ideal Basic Industries, Inc. plant at Baton Rouge, La. In December, the company announced that it would terminate cement production at Baton Rouge on March 31, 1975, and convert the facility to a distribution terminal.

Puerto Rican Cement Co., Inc. signed a consent agreement with the regional office of EPA and the Environmental Quality Board of Puerto Rico that required the company to comply with air pollution control standards through the installation of certain abatement equipment. The consent order protects the company from citizens' suits or abatement actions provided the company follows the terms of the consent order. The 2-year project for the two plants will be financed through a loan from the Government Development Bank of Puerto Rico, to be repaid over 15 years.

The Iowa Air Quality Commission gave Lehigh Portland Cement Co. a final extension until November 1974 to complete installation of dust control equipment but required a 20% curtailment of production from August 15 to November 1.

The Federal Trade Commission (FTC) granted final approval to Holderbank Financiere Glaris Ltd., Switzerland, and St. Lawrence Cement Co., Canada, to transfer portland cement producing assets of the former cement division of BASF Wyandotte Corp. to Wyandotte Cement, Inc., Detroit, Mich. In 1974, Lehigh Portland Cement Co. completed final divestiture required by an FTC consent order by disposing of 6 of its 13 ready-mix concrete plants in Florida. OKC Corp. was seeking to dispose of its investment in OKC Dredging, Inc., formerly Jahncke Service, under terms of an order from FTC. OKC Dredging disposed of its ready-mixed concrete and building materials division. In August, FTC filed a complaint against Gifford-Hill & Co., Inc., seeking divestiture of certain of the company's interests in Georgia and the Carolinas; namely, ready-mixed concrete, prestressed concrete, concrete block, and aggregate businesses.

In March 1974, Centex Corp. settled two of three lawsuits that had been filed against Nevada Cement Co. as a result of dust emissions from the cement plant for a period of time prior to April 1, 1971.

DOMESTIC PRODUCTION

During 1974, 1 State agency and 58 companies operated 182 plants in 41 States and Puerto Rico, manufacturing 1 or more kinds of hydraulic cement.

PORTLAND CEMENT

Manufacturers in the United States and Puerto Rico produced 77,978,000 tons of clinker and imported 1,829,000 tons of foreign clinker to grind 79,486,000 tons of portland cement. Domestic producers shipped 79,482,000 tons of portland cement, which included 1,617,000 tons of imported cement. Stocks at mills, depleted by record shipments in 1973, increased 1.9 million tons. In addition to imported cement shipped by domestic manufacturers, 1.6 million tons of portland cement was imported and shipped or used by others not producing cement in the United States and Puerto Rico.

Table 2.—Portland cement shipped by producers in the United States, by district[1][2]
(Thousand short tons and thousand dollars)

District	1973			1974		
	Quantity	Value	Average per ton[3]	Quantity	Value	Average per ton[3]
New York and Maine	5,679	115,855	$20.40	4,733	121,779	$25.73
Eastern Pennsylvania	6,210	128,998	20.77	5,297	141,321	26.68
Western Pennsylvania	2,354	42,655	18.12	2,150	50,278	23.38
Maryland and West Virginia	2,568	53,432	20.81	2,363	59,116	25.02
Ohio	3,456	73,362	21.23	2,884	73,815	25.59
Michigan	6,242	123,442	19.78	5,903	140,513	23.80
Indiana, Kentucky, Wisconsin	3,642	74,523	20.46	3,189	78,735	24.69
Illinois	1,572	36,064	22.94	1,460	41,023	28.10
Tennessee	1,711	42,402	24.78	1,525	43,339	28.42
Virginia, North Carolina, South Carolina	[r] 2,644	[r] 62,620	[r] 23.68	2,788	78,599	28.19
Georgia	1,201	28,124	23.42	1,150	31,535	27.42
Florida	2,725	72,666	26.67	2,562	75,133	29.33
Alabama	2,396	55,820	23.30	2,190	61,990	28.31
Louisiana and Mississippi	1,533	36,659	23.91	1,701	49,483	29.09
Minnesota, South Dakota, Nebraska	1,712	40,052	23.39	1,583	43,133	27.25
Iowa	2,688	59,574	22.16	2,424	64,156	26.47
Missouri	4,582	99,858	21.79	4,229	106,985	25.30
Kansas	2,026	42,172	20.82	1,940	46,940	24.20
Oklahoma and Arkansas	2,790	60,123	21.55	2,595	67,723	26.10
Texas	8,320	189,368	22.76	7,739	207,706	26.84
Wyoming, Montana, Idaho	1,046	22,437	21.45	1,080	28,124	26.04
Colorado, Arizona, Utah, New Mexico	3,854	92,861	24,09	3,458	94,761	27.40
Washington	1,194	26,651	22.32	1,377	36,347	26.40
Oregon and Nevada	923	20,274	21.97	912	23,283	25.53
Northern California	3,075	64,953	21.12	2,907	73,704	25.35
Southern California	6,321	136,939	21.66	5,355	136,774	25.54
Hawaii	453	13,213	29.17	487	16,405	33.69
Puerto Rico	2,062	41,203	19.98	1,881	70,277	37.36
U.S. total or average[4]	[r][5] 84,978	[r] 1,856,302	21.84	[5] 77,865	2,062,972	26.49
Foreign imports[6]	1,619	38,782	23.95	1,617	44,934	27.79
Total or average[4]	[r] 86,597	[r] 1,895,084	21.88	79,482	2,107,906	26.52

[r] Revised.

[1] Includes data for eight white cement facilities: Texas (three); Pennsylvania (two); one each in California, Florida, and Wisconsin, and for grinding plants (seven in 1973; eight in 1974): Two each in Michigan, Pennsylvania, and Wisconsin, and one each in Florida (1974) and Virginia. Data for the Superior, Wisc., plant are included with Michigan.

[2] Includes Puerto Rico.

[3] Computed prior to rounding.

[4] Data may not add to totals shown because of independent rounding.

[5] Includes cement produced from imported clinker.

[6] Cement imported and distributed by domestic producers only.

Table 3.—Portland cement production, capacity, and stocks in the United States, by district[1] [2]

(Thousand short tons, unless otherwise indicated)

District	1973					1974				
	Plants active during year	Production [3]	Capacity [4]		Stocks [5] at mills December 31	Plants active during year	Production [3]	Capacity [4]		Stocks [5] at mills December 31
			Finish grinding	Percent utilized				Finish grinding	Percent utilized	
New York and Maine	10	5,578	6,597	84.6	r 363	10	4,924	6,560	75.1	546
Eastern Pennsylvania	14	6,158	7,132	86.3	353	14	5,630	7,119	79.1	641
Western Pennsylvania	5	2,427	2,836	85.6	181	5	2,312	2,899	79.8	281
Maryland and West Virginia	4	2,558	3,021	84.7	146	4	2,395	2,962	80.9	194
Ohio	8	3,117	3,535	88.2	215	8	2,918	3,540	82.4	273
Michigan	r 8	6,007	7,538	79.7	570	8	5,844	8,332	70.1	685
Indiana, Kentucky, Wisconsin	9	3,756	4,033	93.1	221	9	3,528	4,569	77.2	341
Illinois	3	1,531	1,741	87.9	109	4	1,592	2,096	76.0	176
Tennessee	6	1,579	2,356	67.0	80	6	1,557	2,208	70.5	116
Virginia, North Carolina, South Carolina	5	r 2,601	3,143	82.8	r 89	6	2,920	4,792	60.9	213
Georgia	3	1,149	1,444	79.6	45	3	1,167	1,482	78.7	86
Florida	4	2,711	2,995	90.5	r 169	5	2,362	3,716	63.6	323
Alabama	7	2,404	2,892	83.1	100	7	2,322	2,947	78.8	205
Louisiana and Mississippi	5	1,479	1,860	79.5	59	6	1,699	2,648	64.2	162
Minnesota, South Dakota, Nebraska	4	1,628	2,229	73.0	124	4	1,594	2,238	71.4	164
Iowa	5	2,529	2,886	87.6	153	5	2,449	2,861	85.6	180
Missouri	7	4,359	4,824	90.4	267	7	4,298	5,150	83.4	396
Kansas	5	2,036	2,141	95.1	163	5	1,996	2,169	92.0	219
Oklahoma and Arkansas	5	2,746	3,394	80.9	177	5	2,695	3,442	78.3	247
Texas	18	8,312	9,902	83.9	465	18	7,889	9,961	79.2	644
Wyoming, Montana, Idaho	4	1,047	1,213	86.3	116	4	1,092	1,218	89.6	106
Colorado, Arizona, Utah, New Mexico	8	3,441	4,750	72.4	192	8	3,351	5,380	62.3	234
Washington	4	1,462	2,260	64.7	192	4	1,389	2,260	61.5	93
Oregon and Nevada	3	908	1,385	65.6	39	3	916	1,385	66.1	45
Northern California	5	2,797	3,541	79.0	231	4	2,723	3,229	84.3	234
Southern California	8	6,705	7,907	84.8	324	8	5,479	7,907	69.3	281
Hawaii	2	467	500	93.5	42	2	474	500	94.8	28
Puerto Rico	3	2,060	2,358	87.4	45	3	1,971	2,658	74.2	43
Total	r 172	r [6] 83,551	100,413	83.2	r 5,230	175	79,486	106,228	74.8	7,156

r Revised.

[1] Includes Puerto Rico.

[2] Includes data for eight white cement facilities: Texas (three); Pennsylvania (two); one each in California, Florida, and Wisconsin, and for grinding plants (seven in 1973; eight in 1974): Two each in Michigan, Pennsylvania, and one each in Florida (1974) and Virginia. Data for the Superior, Wisc., plant are included with Michigan.

[3] Includes cement produced from imported clinker (1973, 2,673; 1974, 1,904).

[4] Grinding capacity based on fineness necessary to grind Types I and II cement, making allowance for downtime required for maintenance.

[5] Includes imported cement. Source of imports withheld to avoid disclosing individual company confidential data.

[6] Data do not add to total shown because of independent rounding.

Thirty-one companies had multiplant operations ranging in number from 2 to 14 plants. Nevertheless, no single company accounted for more than 7.6% of the total clinker production capacity. The 5 largest producers comprised 27.2% of total clinker production capacity, the 10 largest accounted for 47.2%, and the 20 largest had 72.7%. The 10 largest companies in terms of clinker production capacity were Ideal Basic Industries, Inc.; General Portland, Inc.; Martin Marietta Cement; Universal Atlas Cement Div. of United States Steel Corp.; Lone Star Industries, Inc. (including Citadel Cement Corp., a joint venture); Amcord, Inc.; Marquette Cement Manufacturing Co.; Kaiser Cement & Gypsum Corp.; Medusa Cement Co.; and National Gypsum Co. The largest individual plant was at Alpena, Mich., operated by Huron Cement Div. of National Gypsum Co.

Production Capacity.—Three new single-kiln plants (one wet process; two dry process with suspension preheaters) with a combined annual capacity of 1.3 million tons were brought into production early in the year. An additional 9 new kilns started operating at existing plants during the year, while a total of 18 old kilns were permanently removed from service, leaving a net annual capacity increase of about 3 million tons for plant expansions completed. Of the 12 new kilns installed, 7 were wet process and 5 were dry process with suspension preheaters.

At yearend 466 kilns were being operated by 51 companies and a State-owned company in South Dakota at 168 plants in 41 States and Puerto Rico with an estimated 24-hour daily clinker production capacity of 292,700 tons. An average of 55 days' downtime was reported for kiln maintenance and replacing refractory brick. Based on 310 days of operation, the apparent annual clinker production capacity of the industry was 90.9 million tons. However, because of unusually high downtime during the year, the estimated effective annual capacity was 96 million tons, based on 330 working days.

In addition to 168 clinker-producing plants, including 7 white cement facilities, 12 plants operated grinding mills only on imported, purchased, or interplant transfers of clinker. Four of the grinding plants produced only masonry cement, one ground both portland and masonry cements, and seven ground portland cement only. Based on the fineness necessary to grind Types I and II cements and making allowances for downtime required for maintenance, the cement industry in the United States and Puerto Rico had an estimated grinding capacity of 105 million tons of cement annually.

Clinker was produced by wet-process kilns at 100 plants, and by dry-process kilns at 63 plants; 5 plants had both processes in operation. Dry-process kilns with preheaters were becoming increasingly important because of lower fuel consumption. By yearend, 38 kilns equipped with preheaters were in production as follows: 24 suspension preheaters operating at 8 dry process plants and 2 at plants employing both processes; 8 traveling grate preheaters operating at 5 plants; and 7 Grudex preheaters operating on 10 kilns at 2 plants.

With the closing of the white cement facilities at Tampa, Fla., seven white facilities were in operation in the United States. Six of these were operated adjacent to gray cement plants. Table 6 shows the daily clinker production capacities of cement plants in the United States and Puerto Rico, grouped according to relative size.

Table 4.—Clinker capacity and production in the United States, by district, as of December 31, 1973 [1] [r]

District	Active plants [2]				Number of kilns	Daily capacity (thousand short tons)	Average number of days for maintenance	Apparent annual capacity [3] (thousand short tons)	Production [4] (thousand short tons)	Percent utilized
	Process used									
	Wet	Dry	Both	Total						
New York and Maine	7	3	--	10	22	19.7	51	6,181	5,354	86.6
Eastern Pennsylvania	3	8	1	12	52	20.0	47	6,370	5,923	93.0
Western Pennsylvania	3	2	--	5	13	8.0	52	2,505	2,371	94.6
Maryland and West Virginia	2	2	--	4	10	8.1	45	2,589	2,508	96.9
Ohio	5	3	--	8	22	10.1	49	3,189	3,074	96.4
Michigan	5	1	--	6	27	17.5	38	5,722	4,805	84.0
Indiana, Kentucky, Wisconsin	3	5	--	8	20	11.8	37	3,869	3,389	87.6
Illinois	--	3	--	3	8	5.8	71	1,706	1,419	83.2
Tennessee	6	--	--	6	13	5.9	51	1,756	1,660	94.5
Virginia, North Carolina, South Carolina	3	1	--	4	11	6.6	49	2,087	1,959	93.9
Georgia	1	2	--	3	7	3.6	45	1,151	1,086	94.4
Florida	4	--	--	4	12	7.5	36	2,471	2,182	88.3
Alabama	5	2	--	7	18	7.7	49	2,437	2,393	98.2
Louisiana and Mississippi	5	--	--	5	13	5.5	46	1,756	1,469	83.7
Minnesota, South Dakota, Nebraska	3	1	--	4	13	5.2	65	1,562	1,500	96.1
Iowa	3	2	--	5	19	8.2	52	2,567	2,436	94.9
Missouri	5	2	--	7	12	15.2	59	4,644	4,154	89.5
Kansas	3	2	--	5	16	7.0	35	2,307	1,930	83.7
Oklahoma and Arkansas	3	2	--	5	11	8.8	43	2,831	2,600	91.2
Texas	14	3	1	18	47	26.3	39	8,570	7,853	91.6
Wyoming, Montana, Idaho	3	--	1	4	9	3.9	69	1,155	1,027	88.9
Colorado, Arizona, Utah, New Mexico	3	5	--	8	19	12.2	42	3,946	3,322	84.2
Washington	3	1	--	4	7	3.7	37	1,214	1,151	64.7
Oregon and Nevada	2	1	--	3	7	3.3	57	1,018	911	89.5
Northern California	3	2	--	5	15	10.5	64	3,161	2,728	86.3
Southern California	2	5	1	8	33	22.3	46	7,124	6,534	91.7
Hawaii	1	1	--	2	3	2.2	83	730	469	64.2
Puerto Rico	3	--	--	3	12	8.1	85	2,264	2,005	88.5
Total or average	103	59	4	166	471	274.4	48	86,882	78,212	90.0

[r] Revised.

[1] Includes Puerto Rico.

[2] Includes white-cement-producing facilities. Plants not active December 31, 1973: Ideal Cement Co. closed San Juan Bautista plant in July 1973; Amcord, Inc., ceased production at Port Huron and Brennan Avenue plants in January 1973.

[3] Calculated on individual company data: 365 days, minus average days for maintenance, times the reported 24-hour capacity.

[4] Includes production reported for plants that added or shut down kilns during the year.

Table 5.—Clinker capacity and production in the United States, by district, as of December 31, 1974[1]

District	Active plants[2]				Number of kilns	Daily capacity (thousand short tons)	Average number of days for maintenance	Apparent annual capacity[3] (thousand short tons)	Production[4] (thousand short tons)	Percent utilized
	Process used									
	Wet	Dry	Both	Total						
New York and Maine	6	4	--	10	19	19.1	66	5,707	5,104	89.4
Eastern Pennsylvania	3	8	1	12	52	19.9	44	6,388	5,691	89.1
Western Pennsylvania	3	2	--	5	13	8.3	54	2,578	2,308	89.5
Maryland and West Virginia	2	2	--	4	10	8.1	52	2,534	2,444	96.5
Ohio	4	3	1	8	23	11.9	57	3,663	2,918	79.7
Michigan	5	1	--	6	27	18.4	47	5,851	5,169	88.3
Indiana, Kentucky, Wisconsin	3	5	--	8	18	13.2	42	4,265	3,333	78.1
Illinois	--	4	--	4	7	6.3	44	2,020	1,701	84.2
Tennessee	6	--	--	6	13	5.9	52	1,845	1,605	87.0
Virginia, North Carolina South Carolina	3	2	--	5	14	12.7	44	4,075	2,651	65.0
Georgia	--	2	1	3	5	5.0	47	1,591	1,155	72.6
Florida	4	--	--	4	12	7.5	33	2,489	2,051	82.4
Alabama	4	3	--	7	18	8.0	37	2,627	2,345	89.3
Louisiana and Mississippi	6	--	--	6	15	7.9	70	2,329	1,786	76.7
Minnesota, South Dakota, Nebraska	3	1	--	4	13	5.0	36	1,646	1,561	94.8
Iowa	3	2	--	5	19	8.5	61	2,587	2,416	93.4
Missouri	5	2	--	7	12	15.5	63	4,685	4,300	91.8
Kansas	3	2	--	5	16	7.0	39	2,281	1,931	84.6
Oklahoma and Arkansas	3	2	--	5	11	9.1	42	2,943	2,719	92.4
Texas	14	3	1	18	47	26.6	50	8,381	7,758	92.6
Wyoming, Montana, Idaho	4	--	--	4	5	3.3	21	1,136	1,089	95.8
Colorado, Arizona, Utah, New Mexico	3	5	--	8	20	13.7	47	4,356	3,415	78.4
Washington	3	1	--	4	7	3.8	42	1,226	1,121	91.4
Oregon and Nevada	2	1	--	3	7	3.3	66	988	888	89.4
Northern California	2	2	--	4	13	9.2	68	2,729	2,534	92.9
Southern California	2	5	1	8	34	24.0	80	6,832	5,652	82.7
Hawaii	1	1	--	2	3	2.2	37	721	464	64.4
Puerto Rico	3	--	--	3	13	9.3	107	2,401	1,874	78.1
Total or average	100	63	5	168	466	292.7	55	90,874	77,978	85.8

[1] Includes Puerto Rico.
[2] Includes white-cement-producing facilities.
[3] Calculated on individual company data: 365 days, minus average days for maintenance, times the reported 24-hour capacity.
[4] Includes production reported for plants that added or shut down kilns during the year.

Table 6.—Daily clinker capacity, December 31[1]

Short tons per 24-hour period	Number of plants[2]	Number of kilns[3]	Total capacity (tons)	Percent of total capacity
1973:				
Less than 600	7	10	[r] 4,006	1.5
600 to 1,150	43	81	36,540	13.3
1,150 to 1,700	52	143	71,741	26.1
1,700 to 2,300	37	118	69,686	25.4
2,300 to 2,800	7	22	17,692	6.5
2,800 and over	20	97	74,725	27.2
Total	166	471	[r] 274,390	100.0
1974:				
Less than 600	4	7	2,337	0.8
600 to 1,150	45	87	39,723	13.6
1,150 to 1,700	51	130	70,711	24.2
1,700 to 2,300	35	103	68,166	23.3
2,300 to 2,800	12	38	30,624	10.4
2,800 and over	21	101	81,147	27.7
Total	168	466	292,708	100.0

[r] Revised.
[1] Includes Puerto Rico.
[2] Includes white-cement-producing facilities.
[3] Total number in operation at plants.

Capacity Changes.—Three new plants were completed in 1974: Two at new locations and one at an old plant site. In April, Gifford-Hill & Co., Inc., started operating its new $25 million plant at Harleyville, S. C. The 15-foot-diameter by 220-foot-long dry-process kiln is equipped with a four-stage suspension preheater having an annual clinker production capacity of 564,000 tons. Full capacity was expected by February 1975. A double drying process was also installed using a Hazemag crusher-dryer followed by a 15- by 125-foot-rotary dryer. Other major equipment included three 2,500-horsepower ball mills, 12 feet in diameter by 32 feet long; one raw-grinding mill, and two finish-grinding mills. United Cement Co., subsidiary of Texas Industries, Inc., completed its new plant at Artesia, Miss., in late January. The 14-foot-diameter by 500-foot-long wet process kiln has an annual capacity of 376,000 tons. In March, Illinois Cement Co., a joint venture of Centex Corp., started operating a new plant at La Salle, Ill., on an old plant site, formerly owned by Alpha Portland Cement Co. The 13.5-foot-diameter by 190-foot-long dry-process kiln equipped with a four-stage suspension preheater has an annual capacity of 376,000 tons. A Loesche roller mill was installed to grind the raw material, and a 2,000-horsepower, 11-foot-diameter by 34-foot-long ball mill was installed for finish grinding.

During the year, 10 major expansions were completed. Santee Portland Cement Corp. added a new 18-foot-diameter by 580-foot-long wet-process kiln at its Holly Hill, S.C., plant, increasing annual clinker production capacity by 726,000 tons to a total of 1,071,000 tons in early 1974. In the spring, Giant Portland Cement Co. completed installation of a 12.5-foot/11.25-foot/13-foot-diameter by 425-foot-long wet-process kiln, a 10- by 32-foot raw mill, and a 12- by 32-foot finish-grinding mill at Harleyville, S.C. Subsequently, one old kiln was permanently shut down, and the new annual production capacity of the plant became 855,000 tons. In May, three old short wet-process kilns were replaced at Clinchfield, Ga., by Medusa Cement Co. with a new 15-foot-diameter by 220-foot-long dry-process kiln equipped with a four-stage suspension preheater. Annual clinker production capacity was increased from 415,000 tons to 790,000 tons.

Ideal Basic Industries, Inc., started up its $25 million addition at Portland, Colo., in August. The 14-foot/16.5-foot-diameter by 500-foot-long wet-process kiln increased annual clinker production capacity by 470,000 tons to 885,000 tons. Other major equipment installed included three 11- by 34-foot, 2,000-horsepower mills (one raw grinding and two finish grinding), a completely computerized control room, and online X-ray analysis. San Juan Cement Co., Inc., began production in October with a new 13-foot/15-foot-diameter by 523-foot-long wet-process kiln, increasing annual clinker production capacity at its Dorado, Puerto Rico, plant by 376,000 tons to 840,000 tons. An 11- by 38-foot, 2,000-horsepower, raw-grinding mill and a 13- by 42-foot finish-grinding mill were installed, and the kiln was equipped with a planetary clinker cooler. Diamond-Kosmos Cement Division of The Flintkote Co. completed a $25 million modernization and expansion project at its Kosmosdale, Ky., plant in December. A 15-foot-diameter by 220-foot-long dry-process kiln equipped with a suspension preheater increased the annual capacity by 245,000 tons to 658,000 tons.

In late 1974, Southwestern Portland Cement Co. increased the annual capacity of its Fairborn, Ohio, plant by 70,000 tons to 620,000 tons at a cost of $12.5 million. A new 15-foot-diameter by 220-foot-long dry-process kiln equipped with a four-stage suspension preheater and a Loesche roller mill were installed near the raw materials deposit 5 miles from the old plant. Clinker is shipped by rail to the old finish-grinding mills. The two oldest kilns will be permanently retired in 1975, and one older kiln will be placed on standby when needed.

Louisiana Cement Co., Div. of OKC Corp., installed a 12.5-foot/14-foot-diameter by 460-foot-long wet-process kiln at its New Orleans, La., plant, increasing annual production capacity from 320,000 tons to approximately 700,000 tons. New 3,000-horsepower raw- and finish-grinding mills, each 12-feet by 36-feet, were also installed. Kiln modifications at Pryor, Okla., by Oklahoma Cement Co. of OKC Corp., increased annual clinker production capacity from 375,000 tons to 450,000 tons. The two expansions cost about $18 million. Monolith Portland Cement Co. completed installation of a 15.5-foot/17.5-foot-diameter by 520-foot-long wet-process kiln at its plant near Tehachipi, Calif. The new kiln, with an annual capacity of 530,-

000 tons, replaced five old kilns.

In addition to the nine old kilns permanently shut down mentioned above, other companies removed old or obsolete kilns from service. At Humboldt, Kans., The Monarch Cement Co. shut down two obsolete kilns in 1974 with production capacity about equal to that of the new kiln that was completed in 1973. Martin Marietta Cement completed a major rehabilitation of its Buffalo, Iowa, plant in February and shut down two old small kilns with an annual capacity of about 108,000 tons. The remaining annual capacity of the plant is 540,000 tons. In December, General Portland Inc., shut down permanently three small kilns at Tampa, Fla., used to produce white cement. Removal of the white cement facilities reduced the annual capacity of the Tampa plant about 2%. Calaveras Cement Div. of The Flintkote Co., removed two 47-year-old kilns from service at its San Andreas, Calif., plant in January.

Planned Expansions and New Plants.—One new plant and 16 plant modernizations and expansions were under construction and scheduled for completion in 1975. Construction began in early 1974 on a $31 million new plant about 7 miles north of Brooksville, Fla., for Florida Mining and Materials Corp. A 14.5-foot-diameter by 229-foot-long dry-process kiln equipped with a four-stage counterflow suspension preheater will have an annual capacity of 564,000 tons when completed in late 1975. Other equipment includes two 2,500 horsepower finish mills.

Missouri Portland Cement Co. started construction of a new 16-foot/18.7-foot-diameter by 540-foot-long dry-process kiln with a single-stage suspension preheater at its Joppa, Ill., plant to increase the annual capacity by 750,000 tons to 1,314,000 tons. Also the company was installing a 13- by 32.75-foot raw grinding mill and a 16- by 50-foot, 8,000-horsepower grinding unit, reportedly the largest finish mill in the United States. The $28 million expansion was scheduled for completion in late 1975. Citadel Cement Corp. was installing a 16.5-foot-diameter by 190-foot-long modified Lepol-type traveling-grate preheater dry-process kiln at Roanoke, Va., doubling the annual capacity of that plant to 1.2 million tons. Included in the $36 million project are two roller mills for raw grinding and two 13- by 34.5-foot finish mills.

Kaiser Cement & Gypsum Corp. began expansion of its San Antonio, Tex., plant to increase annual clinker production capacity by 335,000 tons to 785,000 tons. The project, costing $11.5 million, includes installation of a 13.5-foot-diameter by 190-foot-long dry-process kiln equipped with a suspension preheater and a roller mill for raw grinding. Under a 15-year contract, 75% of the clinker from the new kiln will be sold to Gulf Coast Portland Cement Co. at Houston, Tex. Universal Atlas Cement Div. of United States Steel Corp., expected to complete modernization and expansion of its Leeds, Ala., plant by yearend 1975. New equipment included a 15-foot-diameter by 220-foot-long dry-process kiln equipped with a four-stage suspension preheater, a Hazemag crusher-dryer, a Loesche roller mill for raw grinding that utilizes an electrostatic precipitator for dust collection, and a 9.5- by 35.8-foot finish-grinding mill. Annual production capacity will be increased by 316,000 tons to 634,000 tons. The company was also modernizing and expanding its Buffington, Ind., gray cement plant facilities by installing a Loesche roller mill for raw grinding and four-stage suspension preheaters on the existing kilns to increase annual capacity by 78,000 tons to 585,000 tons; completion was scheduled for mid-1975.

Northwestern States Portland Cement Co. was installing a 15-foot/13.5-foot-diameter by 500-foot-long dry-process kiln at Mason City, Iowa, to increase annual production capacity by 282,000 tons to 1,032,000 tons. Ash Grove Cement Co. was replacing five old wet-process kilns at Louisville, Nebr., with a new 15.5-foot-diameter by 160-foot-long ACL dry process kiln with a 12- by 80-foot traveling-grate preheater. Annual production capacity will be increased by 236,000 tons when the facility is completed in April 1975. The Whitehall Cement Manufacturing Co. had under construction at its Cementon, Pa., plant, a 12-foot-diameter by 165-foot-long dry-process kiln equipped with a four-stage suspension preheater. Scheduled for completion in May 1975, annual production capacity will be increased by 250,000 tons to 794,000 tons. A 3,500-horsepower finish-grinding mill was expected to be operational in September.

Pennsuco Cement & Aggregates, Inc., subsidiary of Maule Industries, Inc., was installing a third kiln at its plant near Hialeah, Fla. The 19.5-foot/17-foot/18.5-

foot-diameter by 580-foot-long wet-process kiln will increase annual clinker production capacity to 1,128,000 tons when completed by mid-1975. An identical kiln with a capacity of 740,000 tons was planned for 1976.

Martin Marietta Cement in a major modernization and expansion project at Roberta, Ala., was modifying two dry-process kilns by enlarging the diameter of the feed end section to increase the annual capacity of the plant by 150,000 tons to 695,000 tons; completion was scheduled for late 1975. Portland Cement Co. of Utah was installing a new 16-foot-diameter by 300-foot-long wet-process kiln at its plant near Salt Lake City, Utah, to increase annual capacity by 145,000 tons to 383,000 tons. Two old kilns will be removed from service but retained on standby status. New equipment in the modernization and expansion project include a ball mill for raw grinding and a 1,750-horsepower, 11.5- by 17-foot finish-grinding mill.

The Monarch Co. expected to complete construction of its second new 12-foot-diameter by 165-foot-long dry-process kiln equipped with a four-stage suspension preheater in the fall of 1975. After old kilns are removed from service, the annual capacity of the Humboldt, Kans., plant will increase by 140,000 tons to 600,000 tons. A 19-foot-diameter, four-stage counterflow suspension preheater was being added to one of the kilns at Stockerton, Pa., by Hercules Cement Co. When work is completed in 1975, the annual capacity of the plant will be raised by 107,000 tons to 765,000 tons, about a 16% increase. Twelve old kilns were being replaced by two 17-foot/19.5-foot-diameter by 500-foot-long dry-process kilns at Alpena, Mich., by Huron Cement Div. of National Gypsum Co. Annual capacity will remain unchanged at 2.5 million tons when completed. When this phase of the modernization program is completed in September 1975, the plant will have a total of 5 kilns that replaced 22 older kilns. Other plant expansions scheduled for completion in 1975 include Coplay Cement Mfg. Co., increasing annual production capacity by 132,000 tons at Coplay, Pa., and Lone Star Industries, Inc., increasing capacity of its Davenport, Calif., plant by 30,000 tons.

In December, Ideal Basic Industries, Inc., announced intentions to terminate cement production at its Baton Rouge, La., plant on March 31, 1975. The facility will be converted to a distribution terminal.

Plans for six additional plant modernization and expansion programs were announced. These were in various stages of planning and construction with completion scheduled for 1976 or 1977. Citadel Cement Corp. was replacing three old kilns at Demopolis, Ala., with a new dry-process kiln equipped with a suspension preheater, increasing annual capacity by 524,000 tons to 750,000 tons when work is completed in 1976. In a $12.7 million expansion program at Mitchell, Ind., Lehigh Portland Cement Co. was installing a new 11.5-foot/13-foot diameter by 360-foot-long dry-process kiln equipped with a single-stage suspension preheater to increase annual clinker capacity by 250,000 tons to 750,000 tons. Also the company will install a 1,500-horsepower finish-grinding mill with completion of the project scheduled for mid-1976. The South Dakota Cement Commission embarked on a $20 million expansion program to install a 15-foot-diameter by 220-foot-long dry-process kiln equipped with a four-stage suspension preheater. Scheduled for completion by mid-1976, the annual capacity of the Rapid City, S. Dak., plant will be increased by 755,000 tons to 1,032,000 tons. New equipment includes a Loesche roller mill for raw grinding and a 13- by 40-foot finish-grinding mill.

Société des Ciments Vicat, of Grenoble, France, in its first venture in North America, acquired the National Cement Co., Inc. facilities at Ragland, Ala., from the Mead Corp. The National Cement Co., Inc. formerly a division of Woodward Iron Co. plant, has changed ownership five times since it was built in 1908 by Gulf Coast Portland Cement Co. The eminent engineer, L. S. Vicat, a pioneer in the cement industry in the early 1800's, was founder of the French company bearing his name. The new company started a modernization and expansion program to increase annual clinker production capacity from 360,000 tons to 800,000 tons over a 3-year period. Construction was started to erect a four-stage suspension preheater over the existing dry-process kiln. When completed in 1976, the long kiln will be cut nearly in half at the preheater. The new facility incorporates the latest Japanese technology, using auxiliary burners in the preheater for calcining raw materials before entering the kiln to increase output 20% to 30% above that of other suspension preheaters. This is the first installation of its kind in the United States. Subsequently, another finish mill will be added to accommodate grinding the additional clinker.

Monolith Portland Cement Co. planned to install a second wet-process kiln, 15.5-foot/17.5-foot-diameter by 520-foot-long, in 1976, identical to the kiln installed at Monolith, Calif., in 1974; annual capacity increase would be 530,000 tons. Ideal Basic Industries, Inc., was modernizing its Knoxville, Tenn., plant to improve productivity in 1976 by 85,000 tons to its rated annual capacity of 470,000 tons. New equipment to be installed includes a 3,000-horsepower raw-grinding mill to replace three small mills and two 2,000-horsepower finish-grinding mills. Ideal announced plans to build a new plant near Mobile, Ala., with an annual capacity of 1.5 million tons at a cost of $150 million, contingent on certain conditions.

Cement Grinding Facilities.—In addition to the new finish-grinding mills mentioned in the foregoing section, other cement plants increased grinding capacity. Columbia Cement Corp., subsidiary of Filtrol Corp., installed preliminary grinding mills at Zanesville, Ohio, to increase grinding capacity by 10%. Phoenix Cement Co. added a new finish-grinding mill at its Clarkdale, Ariz., plant. Gulf Coast Portland Cement Co. completed construction of a new finish mill that doubled annual grinding capacity to 750,000 tons at its Houston, Tex., plant. Arizona Portland Cement Co. completed its new finish-grinding mill at Rillito, Ariz., to increase annual grinding capacity from 500,000 tons to 1,150,000 tons. Kaiser Cement & Gypsum Corp. made modifications to finish mills at Permanente, Calif., costing $0.55 million and spent another $0.44 million at Cushenburry, Calif., installing a new raw mill to raise the annual capacity of that plant to equal kiln production of 1,015,000 tons. River Cement Co. completed its $6.9 million expansion at Festus, Mo., to bring finish-grinding capacity up to 1.2 million tons, an increase of 28%.

The National Portland Cement Co. of Florida completed its 11- by 34-foot finish-grinding mill at Port Manatec near Bradenton, Fla., with an annual capacity of 282,000 tons. The plant operated on clinker imported from Europe.

Cyprus Hawaiian Cement Corp., subsidiary of Cyprus Mines Corp., was installing a 2,000-horsepower, 11- by 33-foot finish-grinding mill at its plant near Barber's Point, Hawaii. The $6.8 million expansion program to increase annual capacity from 200,000 tons to 275,000 tons was scheduled for completion in early 1975. In 1975, Medusa Cement Co. planned to install a new $3.6 million finish-grinding mill at Clinchfield, Ga., to increase annual grinding capacity from 700,000 tons to 790,000 tons. Marquette Cement Manufacturing Co. announced a $7 million project to modernize finish-grinding mills at its Hagerstown, Md., plant.

In addition to the new National Portland Cement Co. of Florida grinding plant, the following companies operated grinding facilities on imported, purchased, or interplant transfers of clinker: Jefferson Marine Terminal, Detroit, Mich.; Wyandotte Cement, Inc., Wyandotte, Mich.; Lone Star Industries, Inc., Norfolk, Va.; Universal Atlas Cement Div. of United States Steel Corp., Milwaukee, Wisc.; and Allentown Cement Div., National Gypsum Co., West Conshohocken, Pa. G. & W. H. Corson, Inc., produced both portland and masonry cements at its grinding plant in Plymouth Meeting, Pa.

Table 7.—Raw materials used in producing portland cement in the United States[1]

(Thousand short tons)

Raw materials	1973	1974
Calcareous:		
Limestone (includes aragonite)	r 85,699	87,667
Cement rock (includes marl)	26,067	23,417
Oystershell	5,144	4,922
Argillaceous:		
Clay	7,931	7,771
Shale	4,099	3,984
Other (includes staurolite, bauxite, aluminum dross, pumice, and volcanic material)	240	280
Siliceous:		
Sand	2,053	2,235
Sandstone and quartz	748	846
Ferrous: Iron ore, pyrites, millscale, and other iron-bearing material	968	800
Other:		
Gypsum and anhydrite	4,253	4,172
Blast furnace slag	682	805
Fly ash	299	322
Other, n.e.c	5	6
Total	r 138,188	137,227

r Revised.

[1] Includes Puerto Rico.

MASONRY CEMENT

Shipments of masonry cement were 3.4 million tons, down 17% from the record 4.1 million tons shipped in 1973. The unit value increased $3.50 per ton to $32.93, and the total value of shipments was $113 million. By yearend, 114 plants were manufacturing masonry cement. Four plants produced masonry cement exclusively: Cheney Lime & Cement Co., Allgood, Ala.; Martin Marietta Cement, North Birmingham, Ala.; M.J. Grove Lime Div. of The Flintkote Co., Frederick, Md.; and Riverton Corp., Riverton, Va. In some States, masonry cement was not produced because the majority of the masons preferred to purchase portland cement and add clay or lime for plasticity on the job. Despite a decline in sales, masonry cement imports in 1974 were 102,600 tons.

Table 8.—Masonry cement shipped by producers in the United States, by district[1]

(Thousand short tons and thousand dollars)

District	1973			1974		
	Quantity	Value	Average per ton	Quantity	Value	Average per ton
New York and Maine	134	3,609	$26.93	110	3,464	$31.49
Eastern Pennsylvania	321	9,488	29.56	258	9,602	37.22
Western Pennsylvania	169	4,955	29.32	145	5,039	34.75
Maryland and West Virginia	163	4,402	27.01	128	3,878	30.30
Ohio	176	5,641	32.05	158	5,227	33.08
Michigan	247	6,185	25.04	217	6,309	29.07
Indiana, Kentucky, Wisconsin	554	13,099	23.64	470	14,745	31.37
Illinois	88	2,901	32.97	69	3,228	46.78
Tennessee	201	7,908	39.34			
Virginia, North Carolina, South				154	4,706	30.56
Carolina	416	13,593	32.68	332	12,937	38.97
Georgia	67	2,126	31.73	40	1,304	32.60
Florida	256	8,706	34.01	235	4,737	20.16
Alabama	425	13,074	30.76	314	11,322	36.06
Louisiana and Mississippi	51	1,479	29.00	45	1,433	31.84
Minnesota, South Dakota, Nebraska	28	866	30.93	33	1,052	31.88
Iowa	68	2,351	34.57	65	2,660	40.92
Missouri	84	2,400	28.57	75	2,434	32.45
Kansas	73	2,068	28.33	64	2,203	34.42
Oklahoma and Arkansas	126	2,954	23.44	115	3,549	30.86
Texas	234	6,606	28.23	195	6,438	33.02
Wyoming, Montana, Idaho	7	183	26.14	7	239	34.14
Colorado, Arizona, Utah, New Mexico	145	4,204	28.99	119	3,636	30.55
Washington	6	169	28.17	6	193	32.17
Oregon and Nevada Northern California Southern California	2	44	22.00	2	64	32.00
Hawaii	16	537	33.56	14	706	50.43
U.S. total or average	4,057	[2] 119,547	29.47	3,370	[2] 111,107	32.97
Foreign imports[3]	73	1,981	27.14	62	1,923	31.02
Total or average	4,130	121,528	29.43	3,432	113,030	32.93

[1] Does not include quantities produced on the job by masons.

[2] Data do not add to total shown because of independent rounding.

[3] Cement imported and distributed by domestic producers only. Source of imports withheld to avoid disclosing individual company confidential data.

Table 9.—Masonry cement production and stocks in the United States, by district

(Thousand short tons)

District	1973			1974		
	Plants active during year	Production	Stocks[1] at mills December 31	Plants active during year	Production	Stocks[1] at mills December 31
New York and Maine	6	126	7	6	116	13
Eastern Pennsylvania	10	326	22	10	269	33
Western Pennsylvania	5	166	16	5	145	16
Maryland and West Virginia	3	167	6	3	132	6
Ohio	5	169	10	5	160	11
Michigan	4	249	68	4	200	51
Indiana, Kentucky, Wisconsin	5	559	39	5	468	32
Illinois	3	85	5	2	77	13
Tennessee	5	229	13	5	175	13
Virginia, North Carolina, South Carolina	5	417	14	5	336	18
Georgia Florida	5	288	20	5	257	31
Alabama	7	416	17	7	323	26
Louisiana and Mississippi	2	40	2	2	33	3
Minnesota, South Dakota, Nebraska	3	25	10	4	31	8
Iowa	3	61	5	3	69	9
Missouri	4	77	7	4	80	12
Kansas	5	70	19	5	58	13
Oklahoma and Arkansas	5	125	8	5	110	4
Texas	12	250	21	12	216	24
Wyoming, Montana, Idaho	4	8	3	4	7	3
Colorado, Arizona, Utah, New Mexico	6	145	9	6	120	10
Washington	4	7	4	4	4	2
Oregon and Nevada	--	--	(2)	--	--	(2)
Northern California	1	(2)	--	--	--	(2)
Southern California	1	1	--	1	3	1
Hawaii	2	16	2	2	14	2
Total	115	[3]4,022	327	114	[3][4]3,402	354

[1] Includes imported cement.
[2] Less than 500 short tons.
[3] Includes 2,997 tons produced from clinker and 1,025 tons produced from cement in 1973; and 2,558 tons produced from clinker, and 844 tons produced from cement in 1974.
[4] Data do not add to total shown because of independent rounding.

ALUMINOUS CEMENT

Aluminous cement, also known as calcium aluminate cement, high-alumina cement, and "Ciment Fondu," is a nonportland hydraulic cement produced at three plants in the United States. Universal Atlas Cement Div. of United States Steel Corp., manufacured calcium aluminate clinker and cement at a facility adjacent to its gray portland cement plant in Buffington, Ind. The Aluminum Co. of America operated kilns and grinding facilities to produce aluminous cement at Bauxite, Ark. Lone Star Lafarge Co., a joint venture between Lone Star Industries and the Lafarge Group, grinds calcium aluminate cement from imported clinker at Norfolk, Va.

SLAG CEMENT

Slag cement has not been manufactured in the United States since 1972. Some shipments of slag cement were made from stocks at mills during 1973, but no slag cement shipments were made in 1974. The last plants to produce slag cement—Martin Marietta Cement at North Birmingham, Ala., and Cheney Lime & Cement Co. at Allgood, Ala.—experienced considerable difficulty obtaining granulated slag from local steel mills and were unable to purchase an adequate supply elsewhere.

ENERGY

Shortages of fossil fuels and sharp price increases for all fuels were of primary concern to cement manufacturers. Imported fuel oil costs quadrupled, compelling many companies to convert to coal as primary fuel, while others were in various stages of planning and installing coal-handling facilities. Some companies acquired coal resources while others made long-term purchase contracts.

Although Lone Star Industries, Inc. was converting the majority of its plants to coal burning, the company continued to drill for natural gas in Oklahoma, Texas, and New Mexico and made plans for drilling another gas well in Colorado.

Marquette Cement Manufacturing Co. acquired coal properties in 1974 in Sequatchie County, Tenn. The company expects to start mining coal from this property in the second half of 1975 to supply two of its cement plants. Medusa Corp. began strip-mining coal and continued to explore for oil and natural gas.

National Cement Co., Inc., acquired its own coal mine and will convert the Ragland, Ala., plant from natural gas to coal as a primary fuel, utilizing fuel oil as a standby fuel. In 1974, United Cement Co. burned coal that was purchased, but the company anticipates that by 1975 it can ship from company-owned coal mines in Tennessee to its plant at Artesia, Miss.

In September, California Portland Cement Co. acquired an existing underground coal mine near Price, Utah. The mine contains high-quality coal with estimated reserves of recoverable coal in excess of 12.5 million tons that are adequate for 25 years of cement production at all three plants. Soldier Creek Coal Co., a subsidiary of the company, will operate the mine, expected to be in production by yearend 1975. The company was installing coal-burning facilities at each of its three plants in California and Arizona at a cost of about $2.2 million for each plant.

Early in 1974, Ideal Basic Industries, Inc., and Rocky Mountain Energy Co., a subsidiary of Union Pacific Corp., formed a joint venture, Stansbury Coal Co., to reopen and expand an underground coal mine near Rock Springs, Wyo. The mine was scheduled to start production in early 1976 with an initial annual capacity of 1.25 million tons, expandable to 1.5 million tons. Most of the mine's production capacity has been committed under long-term sales contracts, in part to five Ideal cement plants and in part to other customers. The company was exploring a coal deposit in Oklahoma and expects by 1978 to supply six of its plants in the Central States and on the Gulf Coast, including the proposed Mobile, Ala., plant. The company estimates the cost to convert an average size plant to burn coal to be about $2 million.

Until 1973 Kaiser Cement & Gypsum Corp. had a noninterruptible contract for the supply of natural gas to its San Antonio, Tex., plant. A regulatory agency in Texas established a system of priorities that superseded the previous contract, and the plant's supply of natural gas from that source was drastically reduced. In 1975 the plant will be converted to use coal for primary fuel at a cost of $1.6 million.

Petroleum coke was becoming an important fuel in the manufacture of cement. General Portland Inc. converted its dry-process plant in California to use petroleum coke as primary fuel; coke is a refinery waste product and a lower cost fuel. The company's Tampa and Miami, Fla., plants were also converted to use petroleum coke as primary fuel.

Dundee Cement Co. was using additives (pozzolan) as one way to conserve energy. High cost of fuel was responsible for an increase in the production of Type IP, portland-pozzolan cement, and Type IS, portland-blast furnace slag cement. Shipments of Type IP and Type IS in 1974 were 672,000 tons, compared with 1,021,000 tons in 1973, 438,000 tons in 1972, and 104,000 tons in 1971.

Table 10.—Clinker produced in the United States, by kind of fuel [1]

Year and fuel	Clinker produced			Fuel consumed		
	Plants	Quantity (thousand short tons)	Percent of total	Coal [2] (thousand short tons)	Oil (thousand 42-gallon barrels)	Natural gas (thousand cubic feet)
1973:						
Coal	41	[3] 19,009	24.3	[r] 4,717	--	--
Oil	16	[3] 9,444	12.1	--	9,381	--
Natural gas	31	[3] 11,550	14.8	--	--	78,681,049
Coal and oil	11	5,944	7.6	1,026	1,331	--
Coal and natural gas	28	11,058	14.1	1,414	--	40,372,442
Oil and natural gas	35	18,819	24.1	--	2,570	92,263,767
Coal, oil, and natural gas	4	2,388	3.0	308	118	5,707,972
Total	166	78,212	100.0	[r] 7,465	13,400	217,025,230
1974:						
Coal	42	[3] 19,298	24.8	4,724	--	--
Oil	10	[3] 5,801	7.4	--	5,465	--
Natural gas	27	[3] 10,980	14.1	--	--	70,246,514
Coal and oil	16	8,465	10.9	1,367	2,604	--
Coal and natural gas	33	12,950	16.6	1,516	--	47,330,734
Oil and natural gas	31	15,313	19.6	--	1,902	74,842,814
Coal, oil, and natural gas	9	5,170	6.6	487	339	15,962,214
Total	168	[4] 77,978	100.0	8,094	10,310	208,382,276

[r] Revised.

[1] Includes Puerto Rico.

[2] Includes 28 of anthracite, 7,440 of bituminous, and 2 of petroleum coke in 1973; and 42 of anthracite, 7,776 of bituminous, and 276 of petroleum coke in 1974.

[3] Average consumption of fuel per ton of clinker produced was as follows: 1973—coal, 0.24867 ton; oil, 0.993 barrel; and natural gas, 6,812 cubic feet. 1974—coal, 0.24491 ton; oil, 0.942 barrel; and natural gas, 6,398 cubic feet.

[4] Data do not add to total shown because of independent rounding.

Table 11.—Clinker produced and fuel consumed by the portland cement industry in the United States, by process [1]

Year and process	Clinker produced			Fuel consumed		
	Plants active during year	Quantity (thousand short tons)	Percent of total	Coal [2] (thousand short tons)	Oil (thousand 42-gallon barrels)	Natural gas (thousand cubic feet)
1973:						
Wet	103	45,955	58.8	4,270	9,732	143,188,081
Dry	59	29,911	38.2	[r] 3,088	3,483	62,683,137
Both	4	2,346	3.0	107	185	11,154,012
Total	166	78,212	100.0	[r] 7,465	13,400	217,025,230
1974:						
Wet	100	44,977	57.7	4,375	7,846	139,045,793
Dry	63	30,244	38.8	3,405	2,274	59,655,237
Both	5	2,758	3.5	314	190	9,681,246
Total	168	[3] 77,978	100.0	8,094	10,310	208,382,276

[r] Revised.

[1] Includes Puerto Rico.

[2] Includes 28 of anthracite, 7,440 of bituminous, and 2 of petroleum coke in 1973; and 42 of anthracite, 7,776 of bituminous, and 276 of petroleum coke in 1974.

[3] Data do not add to total shown because of independent rounding.

Table 12.—Electric energy used at portland cement plants in the United States, by process [1] [2]

Year and process	Electric energy used						Finished cement produced (thousand short tons)	Average electric energy used per ton of cement produced (kilowatt-hours)
	Generated at portland cement plants		Purchased		Total			
	Active plants	Quantity (million kilowatt-hours)	Active plants	Quantity (million kilowatt-hours)	Quantity (million kilowatt-hours)	Percent		
1973:								
Wet	7	171	101	5,902	6,073	56.0	[r] 49,012	[r] 123.9
Dry [3]	7	548	66	3,913	4,461	41.1	[r] 32,176	[r] 138.6
Both	--	--	4	317	317	2.9	2,363	134.2
Total	14	719	171	10,132	10,851	100.0	[r] 83,551	[r] 129.9
Percent of total electric energy used	--	6.6	--	93.4	--	--	--	--
1974:								
Wet	4	135	98	5,700	5,835	54.6	45,727	127.6
Dry [3]	7	499	70	3,938	4,437	41.5	31,042	142.9
Both	1	11	5	401	412	3.9	2,717	151.6
Total	12	645	173	10,039	10,684	100.0	79,486	134.4
Percent of total electric energy used	--	6.0	--	94.0	--	--	--	--

[r] Revised.

[1] Includes grinding plants and white cement facilities.

[2] Includes Puerto Rico.

[3] Includes data for grinding plants, seven in 1973; eight in 1974.

TRANSPORTATION

Trucks continued to haul most of the cement delivered to customers in the United States. However, railroads and barges transported most cement shipments from manufacturing plants to distribution terminals. Trucks hauled 84% of the total cement shipments to customers, railroads moved 14%, and 2% was transported by water. However, waterborne transportation was becoming increasingly important. Recent studies on comparative efficiencies of various freight modes indicated that 1 gallon of fuel would move 300 ton-miles of freight by water, compared with 180 ton-miles by rail and 50 ton-miles by truck. Other studies expressed the average energy intensiveness of transportation modes in terms of British thermal units (Btu) of energy required to move freight on a ton-mile basis as follows: Inland waterway carriers, 415 Btu per ton-mile; railroads, 750 Btu per ton-mile; pipelines, 1,850 Btu per ton-mile; trucks, 2,400 Btu per ton-mile; and air freight, 63,000 Btu per ton-mile.

Individual long-haul waterway carriers reported fuel requirements considerably below averages; for example, deep-draft vessels such as the iron ore carrier *Charles F. Wilson*, operating on the Great Lakes, consume only 96 Btu per ton-mile. Most recent statistics showed that the cost of shipping by barge was 0.378 cent per ton-mile compared with 1.62 cents per ton-mile by rail, 8.25 cents per ton-mile by truck, and 23.31 per ton-mile by air.

A trend, started in 1972 by many companies to reduce market areas by selective marketing has reduced transportation costs from earlier costs of about 25% to about 10% of the delivered price.

In mid-1974, California Portland Cement Co. acquired the cement distribution terminal at the Port of Redwood City, Calif., from Ideal Basic Industries, Inc. The company was supplying the facility with cement shipped by rail from its Mojave plant. Atlantic Cement Co., Inc. expanded storage capacity at its distribution terminal at Jacksonville, Fla., from 7,500 tons to 38,000 tons. Columbia Cement Corp. enlarged its distribution terminal at Portland, Oreg.

A nonmanufacturer of cement, Rinker Materials Corp. of West Palm Beach, Fla., added two silos to increase storage capacity by 16,000 tons to 40,000 tons and completed bagging facilities at its terminal at Port Everglades, Fla., in April. The company plans to build a new cement terminal at Cape Canaveral, Fla., with storage capacity of 40,000 tons; completion was scheduled for July 1975.

Kaiser Cement & Gypsum Corp. installed a new distribution facility at Phoenix, Ariz., with 400 tons of storage. The company also increased storage capacity from 500 tons to 1,500 tons at its distribution terminal at Lihue on the island of Kauai, Hawaii. In late 1974, Kaiser completed a new $1.4 million distribution facility at Agana, Guam, increasing storage capacity by 800 tons to 9,300 tons. Cement purchased by Kaiser from Asian manufacturers was sold to customers in the Far East, utilizing two company-owned bulk ships, MV *Orient Carrier*—6,000 deadweight tons (dwt) and MV *Taipan*—5,000 dwt.

Missouri Portland Cement Co. had 9 barges under construction to be added to its fleet of 36 company-owned rock and cement barges. The company reported fuel savings up to 80% using water transportation, compared with costs using truck and rail.

Arkansas Cement Corp. was constructing a cement distribution terminal at Alexandria, La. Completion was scheduled for early 1975. Dundee Cement Co. was moving a large metal hopper silo from Monroe, Mich., to its distribution terminal at Lemont, Ill. When the $400,000 project is completed in 1975, the total storage capacity will be increased to 6,500 tons. Cement is transported by barge to the facility.

Single-commodity trains ("commoditrain"), inaugurated by the Chicago and North Western Railroad in 1972, continued to transport cement from two manufacturers in Mason City, Iowa, to distribution terminals in Burnsville, Minn. Trains carrying a minimum load of 2,000 tons make five 275-mile round trips per week during the construction season.

General Cement Co. (AGET) of Greece replaced its 4,800-dwt cement bulk carrier, *Tsimentarches*, which was hit and destroyed in Latakia harbor during 1973 hostilities in the Middle East, with a newly built fully automated 4,200-dwt carrier, *Perseus*, from Norway. In January, its new 6,500-dwt bulk carrier, *Theseus*, was launched in a Japanese shipyard.

Table 13.—Shipments of portland cement from mills in the United States, in bulk and in containers, by type of carrier [1]
(Thousand short tons)

Year and type of carrier	Shipments from plant to terminal		Shipments to ultimate consumer				
			From terminal to consumer		From plant to consumer		Total shipments
	In bulk	In containers	In bulk	In containers	In bulk	In containers	
1973:							
Railroad	7,763	253	1,418	48	11,111	598	13,175
Truck	877	89	r 17,523	734	r 48,572	5,547	r 72,376
Barge and boat	8,670	38	67	--	902	--	969
Unspecified [2]	--	--	18	--	49	11	78
Total	17,310	380	r 19,026	782	r 60,634	6,156	r [3] [4] 86,597
1974:							
Railroad	7,010	205	995	16	9,551	836	11,398
Truck	719	73	16,973	725	44,704	4,601	67,003
Barge and boat	8,815	18	120	--	932	3	1,055
Unspecified [2]	--	--	3	4	17	2	26
Total	16,544	296	18,091	745	55,204	5,442	[3] 79,482

r Revised.

[1] Includes Puerto Rico.

[2] Includes cement used at plant.

[3] Bulk shipments were 92.0% (79,660), and container (bag) shipments were 8.0% (6,938 tons) for 1973. Bulk shipments were 92.0% (73,295 tons), and container (bag) shipments were 7.8% (6,187) for 1974.

[4] Data do not add to total shown because of independent rounding.

Table 14.—Cement shipments, by destination and origin[1]

(Thousand short tons)

	Portland cement[2]		Masonry cement	
	1973	1974	1973	1974
Destination:				
Alabama	1,407	1,311	119	104
Alaska[3]	53	86	W	W
Arizona	1,711	1,385	W	W
Arkansas	866	883	71	66
California, northern	3,135	3,134	(4)	--
California, southern	5,473	4,645	(4)	1
Colorado	1,593	1,339	46	34
Connecticut[3]	906	742	16	15
Delaware[3]	219	180	13	8
District of Columbia[3]	230	330	22	17
Florida	5,850	4,984	455	343
Georgia	2,421	2,227	242	178
Hawaii	453	505	16	14
Idaho	429	418	2	1
Illinois	4,149	3,593	129	117
Indiana	1,838	1,730	125	111
Iowa	1,744	1,763	27	29
Kansas	1,126	1,146	27	29
Kentucky	1,150	1,019	114	101
Louisiana	2,335	2,365	75	61
Maine	278	257	13	12
Maryland	1,525	1,385	129	105
Massachusetts[3]	1,460	1,188	51	44
Michigan	3,198	3,027	179	153
Minnesota	1,762	1,721	54	51
Mississippi	968	911	77	66
Missouri	1,876	1,715	45	43
Montana	282	269	3	3
Nebraska	1,192	1,115	14	15
Nevada	467	369	(4)	(4)
New Hampshire[3]	279	242	13	11
New Jersey[3]	2,252	1,928	87	66
New Mexico	595	586	17	15
New York, eastern	927	719	43	31
New York, western	1,176	1,119	66	55
New York, metropolitan[3]	1,963	1,629	49	42
North Carolina	1,972	1,728	288	227
North Dakota[3]	347	322	8	8
Ohio	3,837	3,327	237	203
Oklahoma	1,419	1,474	66	56
Oregon	835	825	(4)	1
Pennsylvania, eastern	2,276	2,055	86	74
Pennsylvania, western	1,206	1,142	90	79
Puerto Rico	1,947	1,762	--	(4)
Rhode Island[3]	187	175	6	5
South Carolina	1,025	1,066	162	131
South Dakota	334	344	10	10
Tennessee	1,744	1,646	209	174
Texas	6,821	6,359	192	165
Utah	686	684	1	1
Vermont[3]	143	120	6	6
Virginia	r 2,281	2,176	250	195
Washington	1,104	1,167	7	7
West Virginia	707	672	43	38
Wisconsin	1,837	1,621	68	64
Wyoming	204	245	3	3
Total United States	r 88,200	80,875	4,071	3,388
Foreign countries[5]	259	250	88	72
Total shipments	r 88,459	81,125	4,159	3,460
Origin:				
United States[6]	r 82,916	75,877	4,057	3,370
Puerto Rico	2,062	1,988	--	--
Foreign[7]:				
Domestic producers	1,619	1,617	73	62
Others	1,862	1,643	29	28
Total shipments	r 88,459	81,125	4,159	3,460

r Revised. W Withheld to avoid disclosing individual company confidential data; included with "Foreign countries."

[1] Includes cement produced from imported clinker and imported cement shipped by domestic producers, Canadian cement manufacturers, and other imports. Includes Puerto Rico.

[2] Excludes cement (1973—342; 1974—440) used in the manufacture of prepared masonry cement.

[3] Has no cement producing plants.

[4] Less than 500 short tons.

[5] Direct shipments by producers to foreign countries and U.S. possessions and territories; includes States indicated by symbol W.

[6] Includes cement produced from imported clinker by domestic producers (1973—2,673; 1974—1,904).

[7] Imported cement distributed by domestic producers, Canadian cement manufacturers, and other importers. Origin of imports withheld to avoid disclosing individual company confidential data.

Table 15.—Cement shipments by type of customer in 1974[1]
(Thousand short tons)

District of origin	Building material dealers		Concrete product manufacturers		Ready-mixed concrete		Highway contractors		Other contractors		Federal, State, and other government agencies		Miscellaneous including own use		Total[2]
	Quantity	Percent	Quantity	Percent	Quantity	Percent	Quantity	Percent	Quantity	Percent	Quantity	Percent	Quantity	Percent	
New York and Maine	306	6.5	686	14.5	3,567	75.4	93	2.0	52	1.1	1	([3])	29	0.6	4,738
Eastern Pennsylvania	529	10.0	1,364	25.8	3,097	58.5	221	4.2	54	1.0	6	0.1	26	.5	5,297
Western Pennsylvania	241	11.2	319	14.8	1,261	58.7	282	13.1	41	1.9	--	--	5	.2	2,150
Maryland and West Virginia	92	3.9	498	21.1	1,627	68.9	71	3.0	49	2.1	11	.5	15	.6	2,363
Ohio	134	4.6	547	19.0	1,877	65.1	292	10.1	16	.6	1	([3])	17	.6	2,884
Michigan	345	5.8	892	15.1	3,767	63.8	831	14.1	56	.9	5	.1	7	.1	5,903
Indiana, Kentucky, Wisconsin	266	8.3	494	15.5	2,073	65.0	316	9.9	23	.7	--	--	18	.6	3,189
Illinois	115	7.9	129	8.8	978	67.0	189	12.9	48	3.3	1	.1	--	--	1,460
Tennessee	121	7.9	283	18.6	1,003	65.8	64	4.2	8	.5	36	2.4	10	.7	1,525
Virginia, North Carolina, South Carolina	150	5.4	439	15.7	1,846	66.2	313	11.2	35	1.3	5	.2	--	--	2,788
Georgia	104	9.0	191	16.6	637	55.4	162	14.1	51	4.4	4	.3	1	.1	1,150
Florida	184	7.2	567	22.1	1,549	60.5	159	6.2	79	3.1	12	.5	12	.5	2,562
Alabama	147	6.7	391	17.9	1,318	60.2	104	4.7	212	9.7	12	.5	7	.3	2,190
Louisiana and Mississippi	97	5.7	151	8.9	898	52.8	247	14.5	231	13.6	48	2.8	28	1.6	1,701
Minnesota, South Dakota, Nebraska	99	6.3	150	9.5	956	60.4	297	18.8	52	3.3	20	1.3	9	.6	1,583
Iowa	80	3.3	455	18.8	1,568	64.7	302	12.5	13	.5	5	.2	--	--	2,424
Missouri	110	2.6	431	10.2	3,195	75.5	443	10.5	37	.9	1	([3])	13	.3	4,229
Kansas	138	7.1	140	7.2	1,440	74.2	89	4.6	112	5.8	1	.1	20	1.0	1,940
Oklahoma and Arkansas	196	7.6	246	9.5	1,549	59.7	453	17.5	109	4.2	3	.1	38	1.5	2,595
Texas	582	7.5	761	9.8	5,028	65.0	421	5.4	510	6.6	91	1.2	346	4.5	7,739
Wyoming, Montana, Idaho	48	4.4	79	7.3	817	75.6	15	1.4	64	5.9	1	.1	54	5.0	1,080
Colorado, Arizona, Utah, New Mexico	262	7.6	440	12.7	2,414	69.8	82	2.4	140	4.0	3	.1	118	3.4	3,458
Washington	67	4.9	227	16.5	941	68.3	10	.7	36	2.6	11	.8	85	6.2	1,377
Oregon and Nevada	66	7.2	62	6.8	641	70.3	59	6.5	60	6.6	11	1.2	13	1.4	912
Northern California	247	8.5	363	12.5	2,059	70.8	130	4.5	70	2.4	3	.1	34	1.2	2,907
Southern California	543	10.1	746	13.9	3,651	68.2	206	3.8	113	2.1	20	.4	77	1.4	5,355
Hawaii	26	5.3	58	11.9	389	79.9	4	.8	9	1.8	--	--	2	.4	487
Puerto Rico	530	28.2	185	9.8	1,044	55.5	8	.4	79	4.2	33	1.8	3	.2	1,881
Imports[4]	104	6.4	266	16.5	1,100	68.0	85	5.3	52	3.2	3	.2	7	.4	1,617
Total[2]	5,929	7.5	11,560	14.5	52,290	65.8	5,948	7.5	2,411	3.0	348	.4	994	1.3	79,482

[1] Includes Puerto Rico.
[2] Data may not add to totals shown because of independent rounding.
[3] Less than 0.1%.
[4] Cement imported and distributed by domestic producers only. Source of imports withheld to avoid disclosing individual company confidential data.

Table 16.—Portland cement shipped by plants in the United States, by type[1]
(Thousand short tons and thousand dollars)

Type	1973			1974		
	Quantity	Value	Average per ton	Quantity	Value	Average per ton
General use and moderate heat (Types I and II)	r 79,765	r 1,726,904	r $21.65	73,474	1,927,557	$26.23
High-early-strength (Type III)	2,877	66,352	23.06	2,596	71,423	27.51
Sulfate-resisting (Type V)	687	14,985	21.81	323	8,653	26.79
Oil well	654	14,473	22.13	989	27,667	27.97
White	512	23,585	46.06	474	26,697	56.32
Portland slag and portland pozzolan	1,021	22,103	21.65	672	16,843	25.06
Expansive	129	3,772	29.24	132	4,681	35.46
Miscellaneous[2]	952	22,910	24.07	822	24,385	29.67
Total or average	r 86,597	r 1,895,084	21.88	79,482	2,107,906	26.52

r Revised.
[1] Includes Puerto Rico.
[2] Includes waterproof cement.

CONSUMPTION AND USES

Shipments of cement into various States are considered to be an index of consumption. Portland cement consumption decreased 8% below the 1973 record shipments. Consumption shown in table 14 decreased in all but 12 States and shipping districts. The largest decrease was in Florida with 866,000 tons; followed by Southern California, 828,000 tons; Illinois, 556,000 tons; Ohio, 510,000 tons; and Texas, 462,000 tons. The largest increase was in the District of Columbia with 100,000 tons, followed by Washington with 63,000 tons, and Oklahoma with 55,000 tons. Consumption in northern California and Utah was virtually unchanged from shipments in 1974.

Producers of ready-mix concrete were the primary customers for portland cement, receiving 65.8% of total shipments. Concrete product manufacturers used 14.5% of the cement to make concrete blocks, concrete pipes, precast-prestressed concrete, and other concrete products. Direct shipments to highway contractors amounted to 7.5% of the total cement consumed during the year. Building materials dealers received 7.5% of the shipments, other contractors received 3.0%, Federal, State and other government agencies purchased 0.4%, and 1.3% went for miscellaneous uses.

New housing unit starts in 1974 were down 34% below those in 1973; nevertheless, because of inflation, the value of new construction put in place was down only one half percent. Private construction value decreased 6% below the 1973 record, while value of public construction increased 18%. Residential construction value was down 23% for single-unit and multi-unit housing combined. Value of total private nonresidential buildings was up 8%, led by industrial construction, 24%; farm (other than residential), 25%; office buildings, 4%; other commercial buildings, 3%; hospitals and institutional buildings, 5%; and religious construction, 16%. Private educational building declined 20%. Private public utilities construction value was up 11%, led by electric power construction, 11%; and telephone, 8%. Total value of public construction advanced 15%, comprising the following increases: Sewer systems, 37%; water supply facilities, 29%; conservation and development, 20%; highways, 15%; hospitals, 24%; industrial, 26%; educational, 10%; and other public buildings, 23%.

PRICES

The average mill value[3] of portland cement (all types) was $26.52 per ton in 1974, an increase of $4.64 per ton. The mill values ranged from lows of $23.80 in Michigan and $24.20 in Kansas to highs of $29.33 in Florida, $33.69 in Hawaii, and $37.36 in Puerto Rico.

The Bureau of Mines collects mill value for cement shipments but does not canvass cement prices. However, according to

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[3] Mill value is the actual value of sales to customers, f.o.b. plant, less all discounts and allowances, less all freight charges to customers, less all freight charges from producing plant to distribution terminal, if any; less total cost of operating terminal, if any; less cost of paper bags and pallets.

Engineering News-Record, December bulkmill prices ranged from $26.60 in Hagerstown, Md., to $57.60 in Waianae, Hawaii. Bagged cement prices were $6 to $10 per ton higher than bulk prices. All prices were subject to cash discounts. Base prices for portland cement in carload lots f.o.b. were reported monthly in Engineering News-Record for 20 cities in the United States. The December 1974 average for bulk cement was $33.45 per ton, compared with $26.76 in December 1973. In the 20-city survey, bulk prices ranged from a low of $30.40 per ton in Pittsburgh, Pa., to highs of $37.40 per ton in Boston, Mass., and $37.20 per ton in San Francisco, Calif. Masonry cement averaged $50.70 per ton in December 1974 and ranged from $43.14 per ton in Birmingham, Ala., to $65.71 per ton in Kansas City, Kans.

The Department of Consumer Affairs, in Puerto Rico, which attained cabinet status in 1973, regulates consumer prices. In January, an emergency price increase of 25 cents was granted, raising the price of a bag of cement at the manufacturers level to $1.85, followed by another 7-cent increase in April. On July 18, 1974, the Department of Consumer Affairs approved a new pricing structure for cement in Puerto Rico that creates a price differential between bagged and bulk cement and granted price increases of 26.05 cents for bagged cement and 0.0005 cent for bulk cement. Approximately 47% of the cement is sold in bags. The new price structure also allows automatic "pass throughs" for increases in certain cost items such as fuel, power, local transportation, gypsum, and property taxes. These costs account for about 60% of the cost of producing cement. By yearend, the price of a bag of cement was $2.239 bagged and $1.979 bulk equivalent. Beginning January 1, 1975, a new price formula will provide for a reasonable return on capital invested in the production of cement, with an objective of 12% return.

Skyrocketing fuel prices and inflation rates, much higher than in the United States, were responsible for substantial increases in foreign cement prices. A sampling of price increases above 1973 prices for selected countries follows: Kingston, Jamaica, 81%; Beirut, Lebanon, 77%; Tel Aviv, Israel, 77%; Singapore, 73%; Milan, Italy, 72%; Athens, Greece, 62%; Ankara, Turkey, 52%; Buenos Aires, Argentina, 42%; Tehran, Iran, 37%; Stockholm, Sweden, 36%; Tokyo, Japan, 26%; Sidney, Australia, 25%; Paris, France, 22%; Rio de Janeiro, Brazil, 18%; Brussels, Belgium, 17%; New Delhi, India, 17%; and Panama, 16%. While the bag price was unchanged in Lima, Peru, the size of the sack of cement was reduced from 93 pounds to 26 pounds.

Table 17.—Average mill value in bulk of cement in the United States[1]
(Per short ton)

Year	Portland cement	Prepared masonry cement[2]	All classes of cement
1970	$17.69	$22.68	$17.88
1971	18.74	25.28	19.01
1972	20.31	26.52	20.59
1973	21.88	29.43	[r] 22.23
1974	26.52	32.93	26.79

[r] Revised.
[1] Includes Puerto Rico.
[2] Masonry cement made at cement plants only.

FOREIGN TRADE

Although hydraulic cement exported from the United States decreased 11% in quantity, the value increased 65%. In relative importance, cement exports amounted to less than 0.4% of the quantity and 0.8% of the value of total domestic shipments. Six countries—Canada, the Dominican Republic, Mexico, the Netherlands Antilles, the Leeward and Windward Islands, and Jamaica—received 88% of the 289,800 tons of cement valued at $14,860,000 exported to 82 countries.

Portland cement and clinker imported from 16 countries, for consumption in the United States and Puerto Rico, decreased 14% in quantity and 2% in value from the record 1973 imports. Nevertheless, despite an 8% decrease in domestic production caused by a general economic recession, imports comprised 7% of total domestic cement shipments. Nearly 60% of the imports entered at Customs Districts in two States—Florida (37.5%) and New York (22.4%).

Canada continued to be the leading exporter, supplying 39% of the imported cement and clinker, followed by the Bahamas with 14%; Norway and the United Kingdom, 12% each; France, Spain, and West Germany, 5% each; and Mexico, 4%.

Clinker comprised 32% of the total imports in 1974, compared with 41% in 1973, 34% in 1972, 24% in 1971, and 15% in 1970. Four plants operated exclusively on imported clinker—two in Michigan and one each in Florida and Virginia. An additional 15 plants supplement their cement production by grinding imported clinker.

While imports comprised 7% of domestic shipments, cumulative total imports of 5.7 million tons exceeded the quantity of cement manufactured in all individual producing States with the exception of California, Pennsylvania, and Texas.

The rate of duty on white, nonstaining portland cement was 1.0 cent per hundredweight including the weight of container; other hydraulic cement and clinker were duty free, as granted in the final stage of the Kennedy round of trade negotiations under the General Agreement on Tariffs and Trade (GATT). However, the statutory import duty from countries that do not have most-favored-nation status was 8 cents per hundredweight for white, nonstaining portland cement and 6 cents per hundredweight for other hydraulic cement and clinker.

World trade of cement and clinker was about 30 million tons, out of 780 million tons comprising total world shipments.

Table 18.—U.S. exports of hydraulic cement, by country

Country	1972		1973		1974	
	Quantity (short tons)	Value (thousands)	Quantity (short tons)	Value (thousands)	Quantity (short tons)	Value (thousands)
Austria	168	$25	85	$18	152	$37
Australia	282	25	554	27	269	82
Bahamas	2,722	181	1,514	94	4,184	230
Belgium-Luxembourg	542	28	98	24	169	43
Belize	142	6	--	--	488	26
Bermuda	293	25	269	20	75	20
Brazil	528	17	881	20	120	47
Canada	57,862	1,729	168,182	8,635	125,824	6,008
Chad	--	--	564	26	--	--
Chile	1,018	66	707	42	108	19
Costa Rica	512	16	646	28	51	17
Dominican Republic	810	34	16,045	269	48,941	1,072
Ecuador	1,126	58	266	12	751	58
Ethiopia	108	6	564	29	--	--
France	116	15	436	30	181	38
French West Indies	76	3	966	11	1,086	28
Germany, West	444	84	374	60	108	30
Ghana	--	--	21	(1)	705	41
Guatemala	--	--	347	20	1,576	122
Haiti	118	5	48	5	1,005	27
Honduras	357	16	546	28	68	15
Indonesia	86	5	1,200	86	1,721	95
Iran	836	18	8,081	149	46	18
Ireland	168	18	232	22	129	20
Italy	483	32	424	35	700	99
Jamaica	409	24	1,272	54	10,153	296
Japan	1,360	246	2,840	444	2,207	661
Korea, Republic of	106	5	318	33	86	28
Kuwait	98	2	260	7	16	11
Leeward and Windward Islands	9,669	100	17,173	174	15,419	308
Malagasy	--	--	475	23	--	--
Mauritania	--	--	475	21	--	--
Mexico	5,036	316	68,391	2,355	38,765	3,018
Netherlands Antilles	7,970	81	28,601	249	16,067	334
New Guinea	--	--	1,140	51	--	--
Nicaragua	58	6	130	5	349	44
Niger	--	--	--	--	998	56
Norway	409	20	262	7	26	21
Oman [2]	--	--	487	58	--	--
Pakistan	11	9	1,425	64	2	1
Panama	100	14	238	25	248	47

See footnotes at end of table.

Table 18.—U.S. exports of hydraulic cement, by country—Continued

Country	1972		1973		1974	
	Quantity (short tons)	Value (thousands)	Quantity (short tons)	Value (thousands)	Quantity (short tons)	Value (thousands)
Peru	30	$1	584	$32	4,182	$275
Philippines	174	15	207	35	1,710	151
Saudi Arabia	402	33	1,201	67	737	100
Singapore	90	19	299	30	5,126	244
South Africa, Republic of	66	18	140	19	118	30
Spain	195	20	198	32	119	30
Sweden	352	26	37	5	261	91
Switzerland	932	72	587	81	178	75
Taiwan	204	9	193	23	251	163
Trinidad and Tobago	383	16	365	22	82	29
Trust Territory of the Pacific Islands	376	(1)	905	38	60	3
Turkey	539	15	109	3	1	(1)
United Kingdom	431	28	436	54	434	91
Venezuela	175	19	1,298	113	985	202
Yugoslavia	29	15	93	20	348	87
Other	2,993	186	2,051	151	2,529	337
Total	100,889	3,712	324,740	8,980	289,844	14,860

[1] Less than ½ unit.
[2] Prior to January 1972, part of Arab Peninsula States.

Table 19.—U.S. imports for consumption of hydraulic and clinker cement, by country
(Thousand short tons and thousand dollars)

Country	1973		1974	
	Quantity	Value	Quantity	Value
Austria	--	--	(1)	(1)
Bahamas	[r] 947	[r] 16,965	830	20,015
Belgium-Luxembourg	18	812	20	1,035
Canada	2,779	[r] 41,797	2,245	37,149
Colombia	--	--	23	449
Denmark	--	--	1	61
France	302	4,798	315	5,246
Germany, West	33	816	267	4,338
Guatemala	(1)	4	--	--
Guyana	(1)	1	--	--
Honduras	[r] 22	[r] 436	3	63
Italy	42	225	--	--
Japan	1	14	16	443
Mexico	273	4,346	220	2,993
Norway	676	10,766	678	11,589
Spain	361	6,123	271	4,773
Sweden	41	817	88	1,628
United Kingdom	1,149	15,614	662	10,069
Venezuela	40	502	91	1,766
Yemen	(1)	2	--	--
Yugoslavia	2	90	2	117
Total	[r] 6,686	[r] 104,128	5,732	101,734

[r] Revised.
[1] Less than ½ unit.

Table 20.—U.S. imports for consumption of cement
(Thousand short tons and thousand dollars)

Year	Roman, portland, and other hydraulic cement		Hydraulic cement clinker		White nonstaining portland cement		Total	
	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value
1972	3,192	51,115	1,691	19,672	28	970	4,911	71,757
1973	[r] 3,914	[r] 67,450	2,743	35,501	29	1,177	[r] 6,686	[r] 104,128
1974	3,870	73,315	1,829	26,787	33	1,682	5,732	101,734

[r] Revised.

Table 21.—U.S. imports for consumption of hydraulic and clinker cement, by customs district and by country

(Thousand short tons and thousand dollars)

Customs district and country	1973		1974	
	Quantity	Value	Quantity	Value
Anchorage:				
Canada	54	1,107	44	1,086
Japan	(1)	1	--	--
Total	54	1,108	44	1,086
Baltimore:				
Denmark	--	--	(1)	1
Germany, West	--	--	(1)	69
Total	--	--	(1)	70
Boston:				
Belgium-Luxembourg	(1)	22	--	--
Canada	1	22	(1)	1
Total	1	44	(1)	1
Bridgeport: Canada	--	--	1	16
Buffalo:				
Austria	--	--	(1)	(1)
Canada	677	9,783	657	10,200
Yemen	(1)	2	--	--
Total	677	9,785	657	10,200
Charleston:				
United Kingdom	273	3,617	--	--
Chicago:				
Canada	70	1,050	49	882
Germany, West	(1)	1	--	--
Total	70	1,051	49	882
Cleveland: Canada	(1)	134	47	1,032
Detroit:				
Canada	477	5,591	460	6,142
Spain	173	2,747	69	1,274
Total	650	8,338	529	7,416
Duluth: Canada	102	1,327	79	1,213
El Paso:				
Guatemala	(1)	4	--	--
Mexico	35	658	13	320
Total	35	662	13	320
Galveston:				
Germany, West	(1)	3	--	--
United Kingdom	103	1,521	27	316
Total	103	1,524	27	316
Great Falls: Canada	2	57	4	103
Honolulu: Japan	1	13	16	443
Houston:				
United Kingdom	169	2,005	140	2,143
Laredo: Mexico	r (1)	12	(1)	2
Los Angeles:				
Germany, West	(1)	16	(1)	6
Spain	1	55	(1)	16
Total	1	71	(1)	22
Miami:				
Bahamas	r 226	r 4,082	216	5,184
Belgium-Luxembourg	2	78	2	50
Canada	222	r 2,692	42	560
Germany, West	--	--	200	2,903
Honduras	5	96	--	--
Italy	42	225	--	--
Mexico	30	461	--	--
Norway	238	4,671	292	5,530
Spain	1	180	73	1,031
Sweden	41	817	88	1,628
United Kingdom	548	7,577	364	5,545
Venezuela	--	--	10	196
Total	r 1,355	r 20,874	1,287	22,627
Milwaukee: Canada	64	1,428	46	1,289
New Orleans:				
United Kingdom	--	--	108	1,710

See footnotes at end of table.

Table 21.—U.S. imports for consumption of hydraulic and clinker cement, by customs district and by country—Continued

(Thousand short tons and thousand dollars)

Customs district and country	1973		1974	
	Quantity	Value	Quantity	Value
New York City:				
Canada	(1)	(1)	--	--
Germany, West	(1)	4	(1)	8
Norway	438	6,095	386	6,059
Total	438	6,099	386	6,067
Nogales: Mexico	(1)	1	--	--
Norfolk:				
Bahamas	153	3,154	173	4,235
France	302	4,787	315	5,223
Spain	42	501	18	302
United Kingdom	46	595	23	349
Total	543	9,037	529	10,109
Ogdensburg:				
Canada	320	5,853	240	4,603
United Kingdom	--	--	(1)	1
Total	320	5,853	240	4,604
Pembina:				
Canada	163	[r] 3,219	119	2,577
Guyana	(1)	1	--	--
United Kingdom	(1)	1	(1)	(1)
Total	163	3,221	119	2,577
Philadelphia:				
Bahamas	--	--	2	46
Canada	--	--	--	--
Germany, West	4	416	3	390
Yugoslavia	2	90	2	117
Total	6	506	7	553
Portland, Maine:				
Canada	19	423	62	1,086
St. Albans:				
Canada	165	3,500	126	2,795
United Kingdom	(1)	1	--	--
Total	165	3,501	126	2,795
San Juan:				
Belgium-Luxembourg	13	611	17	952
Denmark	--	--	1	60
France	(1)	11	(1)	23
Germany, West	--	--	(1)	1
Spain	26	600	12	580
Total	39	1,222	30	1,616
Savannah: Spain	88	1,500	53	830
Seattle: Canada	336	3,982	269	3,564
Tampa:				
Bahamas	568	9,729	439	10,550
Belgium-Luxembourg	3	106	1	33
Canada	107	1,679	--	--
Colombia	--	--	23	449
Germany, West	29	376	64	961
Honduras	[r] 17	[r] 340	3	63
Mexico	208	3,214	207	2,671
Spain	30	540	46	740
United Kingdom	10	297	--	--
Venezuela	40	502	81	1,570
Total	[r] 1,012	[r] 16,783	864	17,037
Grand total	[r] 6,686	[r] 104,128	5,732	101,734

[r] Revised.
[1] Less than ½ unit.

WORLD REVIEW

In 1974, about 1,700 clinker-producing cement plants in some 140 countries were operating, with an estimated total annual capacity of 900 million tons. In addition, more than 2,800 very small plants were reportedly operating in many communes and municipalities in the People's Republic of China, accounting for more than 50% of that country's estimated 35-million-ton capacity. Many new plants, plant expansions, and plant modernizations were under construction or in various stages of planning and financing throughout the world.

The world cement situation continued to be a dichotomy of chronic shortage in many countries, particularly in Asia, Latin America and Africa, while considerable surplus existed in North America, Europe and some countries in the Far East. The serious economic recession, high inflation, high interest rates, and sharply rising fuel costs experienced in the United States affected the economies of most other countries and specifically their construction industries.

A construction slump in 19 European countries belonging to the European Cement Association (CEMBUREAU) was responsible for a 2.6% decrease in cement production in 1974, the first decline since World War II. Many kilns and some plants were taken out of production because of the depressed market. Nevertheless, during the year, seven new plants with a combined annual capacity of 3.5 million tons started operations in member countries. An additional 19 new kilns went into production with a combined annual capacity of 12.2 million tons. Six new plants and 15 plant expansions were under construction that will increase annual clinker production capacity by 14.3 million tons when completed in 1975.

Although cement price increases ranged from 7% to 105% in member countries, cement prices rose an average of 30% following sharp increases in fuel and power costs combined with the inflationary trend of all manufacturing cost items.

Algeria.—Société National des Materiaux de Construction (S.N.M.C.) was expanding production capacity at its Zahana plant about 22 miles southeast of Oran with a new 18-foot-diameter by 275-foot-long-dry-process kiln equipped with a four-stage suspension preheater. Annual clinker production capacity will be increased by 1.1 million tons when completed in early 1977. The company announced plans for construction of a new plant at El Asnam about 99 miles southwest of Algiers. The dry-process kiln equipped with a suspension preheater will have an annual capacity of 1.1 million tons. Completion was expected in early 1979. S.N.M.C. was constructing a 14.5-foot-diameter by 230-foot-long kiln equipped with a four-stage suspension preheater at its Hadjar Soud plant. The new addition will have an annual capacity of 550,000 tons, the same as the first unit.

Barbados.—The Governments of Barbados and Guyana proposed to build a cement plant in Barbados with an initial capacity of 270,000 tons. Clinker would be shipped to the state-owned Guyana Bauxite Co. Ltd. (Guyban) for finish grinding. Completion was scheduled for May 1976.

Belgium.—In October, S.A. Cimenteries C.B.R. Cementliedryuen U.V. started operating a new slag-cement plant with an annual capacity of 550,000 tons near Gent. The company, in a joint venture with Eerste Nederlandse Cement Industrie, was constructing a new kiln at its Lixhe plant with an annual capacity of 1.1 million tons. Completion was expected in 1976. Ciments d'Obourg S.A. was installing a 23.5-foot/20.8-foot-diameter by 745-foot-long wet-process kiln with production capacity of 1.1 million tons at its Obourg plant. The new kiln, one of the largest in the world, was scheduled for production by mid-1975.

Bhutan.—The Bhutan Government contracted for a cement plant with an annual capacity of 110,000 tons to be constructed at Pagli. Completion was expected in 1978.

Brazil.—Cimento Tupi, S.A., was constructing a new plant, with a 15-foot-diameter by 220-foot-long kiln with a suspension preheater, at Pedro de Sino in Minas Gerais that was scheduled for completion in late 1975. Ube Industries, Ltd., and Nissho-Iwai Co. of Japan, in a joint venture with Brazilian firms, formed the company Industrias de Cimento Portland Cantagalo S.A. to build a cement plant with a daily capacity of 2,640 tons at Cantagalo near Rio de Janeiro. Completion was scheduled for late 1975. Cia. de Cimento Nacional de Minas S.A. (CIMINAS) started operation of its Pedro Leopoldo plant, with a dry-process kiln equipped with a four-stage suspension preheater in December 1974. Annual capacity of the plant, located near Belo Horizonte, Minas Gerais, was 990,000 tons.

Bulgaria.—The Bulgarian Government was seeking bids to construct a cement plant with an annual capacity of 2 million tons.

Burma.—Plans were made to establish a new $25 million cement plant with an annual capacity of 240,000 tons at Kyaukse about 20 miles south of Mandalay. Construction will be implemented with assistance from the People's Republic of China. When completed in 1978, Burma's production capacity will be 864,000 tons.

Canada.—Canada Cement LaFarge Ltd. installed a new kiln at its St. Constant, Quebec plant, which doubled the annual capacity to 1 million tons at a cost of $25 million. After the company completed its new dry-process (single-stage preheater) plant with production capacity of 1.1 million tons at Bath, Ontario, in September 1973, the old Bellville, Ontario, plant was phased out. The company was replacing two old kilns at its Exshaus, Alberta, plant with a new kiln with a production capacity of 500,000 tons that will increase the plant capacity by 200,000 tons when completed in 1975 at a cost of $30 million. Also the company was modernizing its Havelock, New Brunswick, plant to increase annual capacity by 100,000 tons. Canada Cement LaFarge Ltd. announced a $13 million modernization of its Montreal East plant, converting from a wet to a dry process. Completion was scheduled for late 1976.

Lake Ontario Cement Ltd., in the second phase of a major expansion of its Picton, Ontario, plant, was installing a new dry-process kiln equipped with a four-stage suspension preheater, having an annual capacity of 850,000 tons. When it is completed in late 1975, older kilns will be placed on standby. St. Mary's Cement Company Ltd. completed installation of a new kiln at its Bowmanville plant that increased annual capacity to 700,000 tons. The company planned to double the capacity of its St. Marys, Ontario, plant by late 1976. The expansion will include a new kiln with an annual capacity of 500,000 tons that was estimated to cost $30 million.

Genstar Ltd. announced plans to build a new $60 million plant on the British Columbia mainland with production capacity of 750,000 tons. Haida Cement Co. Ltd., a newly formed company, planned to build a plant at New Westminster, British Columbia, with completion scheduled for late 1975. Equipment will include a dry-process kiln equipped with a suspension preheater having an annual capacity of 330,000 tons. Houg Cement Ltd. planned to build a small cement plant near Clyde, about 40 miles northeast of Edmonton, Alberta.

Central African Republic.—Plans were revised to erect the clinker-grinding plant at Bangui, with an annual capacity of 55,000 tons.

China, People's Republic of.—About 2,800 small cement plants were reportedly operating in 80% of China's counties, accounting for more than 50% of the national cement output. Quality of the cement was improved. Following is a brief summary of small cement plants in some provinces and autonomous regions. In Honan Province more than 140 small plants have produced about 6.6 million tons of cement since 1970. Sinkiang had 37 small plants, accounting for 66% of the Province's cement output. Sinkiang's first small plant has an annual capacity of 22,000 tons. Kwangsi had 112 small cement works established since 1966 in 80 counties or cities. Tsinghai Province had 17 plants, with a yearly output of 55,000 tons. Kansu Province had more than 80 small cement plants, accounting for one-third of the Province's total output. The Wuwei County plant achieved an annual output of 7,500 tons. Seventy-one counties in Slensi Province operated small works, accounting for 41% of the Province's total cement output. The Tachai cement plant in the Siyang district of Shansi Province increased annual capacity from 7,700 tons to 22,000 tons by modification of the vertical kilns. Potash was recovered for fertilizer from the kiln dust.

The Liku plant in the Hsinhsiang region of Honan Province increased daily output to more than 330 tons and reduced the cost from 88 yuan to 31 yuan per ton.[3]

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[3] 1 yuan=about $2.2.

The Maanshan municipal cement plant in Anhwei Province increased annual output to 33,000 tons of grades 400 and 500 cement. Puyi-Miao Autonomous Chou in south Kweichow has eight cement works. Tungtuchen, capital of Haman Li Miao Autonomous Chou, is a new city that recently established a cement works with an annual capacity of 11,000 tons.

China has more than 50 large plants, some with capacities exceeding 1 million tons. The capacity of the country's cement industry was estimated to be more than 33 million tons.

Colombia.—Cementos Boyacá S.A. was installing a new cement mill, 13.8 feet in diameter by 44.5 feet long, and slag-drying equipment that will enable the production of slag cement at its Nobsa plant. The new 4,500-horsepower grinding mill with an hourly capacity of 98 tons was expected to be in operation during the second half of 1975. Compañía Colombiana de Clinker S.A., a newly organized company, was building a plant near Cartagena. Equipment will include two wet-process kilns with a combined daily capacity of 2,200 tons.

Costa Rica.—In September, Industria Nacional de Cemento S.A. completed the conversion of an idle wet-process kiln to a dry-process kiln equipped with a two-stage suspension preheater. This increased the annual capacity of the Cartago plant by 165,000 tons to 495,000 tons.

Cyprus.—Cyprus Cement Co., Ltd., was installing a new kiln to increase the capacity of its Limassol plant by 275,000 tons to 385,000 tons.

Denmark.—A new kiln was installed at the Rordal plant by A/S Aalborg Portland Cement-Fabrik (APCF). Production capacity was increased by 275,000 tons per year. On January 1, 1975, APCF will become the country's sole cement producer when it acquires Dansk Andels Cement Fabric A.m.b.a.

Dominican Republic.—Cementos Nacionales S.A. was constructing a new cement plant near the port of San Pedro de Macoris about 43 miles east of Santo Domingo. The dry-process kiln, 15 feet in diameter by 220 feet long and equipped with a suspension preheater, has an annual capacity of 560,000 tons and was scheduled for completion in September 1975.

Ecuador.—La Cemento Nacional C.A. was planning expansion of annual capacity at its San Eduardo plant near Guayaquil by 550,000 tons. Equipment includes a 14.5-foot-diameter by 204-foot-long dry-process kiln equipped with a suspension preheater and a 13-foot by 41-foot, 4,000-horsepower finish-grinding mill.

Egypt.—Ste. Egyptienne de Ciment Portland Tourah was planning to expand the annual capacity of its Tourah plant near Cairo from 1.4 to 2.1 million tons, with an addition of a dry-process kiln.

Finland.—Paraisten Kalkkivuori Oy was replacing two old kilns with a new dry-process kiln at its Pargas plant, 22 miles south of Turku. When completed in January 1975, the capacity will be increased by 500,000 tons. Lohjan Kalkkitehdas Oy was changing its plant at Virkkala with an annual capacity of 1.1 million tons from wet to dry process.

France.—S.A. des Ciments Portland de Lorraine installed a new kiln at its Heming plant with an annual capacity of 495,000 tons. Ciments d'Origny Desvroise completed construction of a kiln with an annual capacity of 545,000 tons at its Lumbres plant. Société des Ciments Français replaced an old kiln with a new kiln and increased production capacity at its Couvrot plant by 1.08 million tons. S.A. des Ciments de Dannes et Lavocat had a new kiln under construction at the Dannes plant to replace two old kilns; this kiln should increase annual capacity by 154,000 tons when completed in 1975. Ciments LaFarge was constructing two kilns with combined capacity of 110,000 tons at Dunkerque to produce "Fondue" aluminous cement; completion was scheduled for 1975.

Germany, West.—Six new kilns, which increased the country's annual capacity by about 2.2 million tons, were installed during the year by Anneliese Portland Cement and Wasser Kalkwerke A.G. at Ennigerloh (1.1 million tons); Buderus'sche Eisenwerke Wetzlav at Wetzlav (1.1 million tons); Portland-Zementwerke Heidelberg A.G. at Burg-Lengenfeld (715,000 ton); Märker Zementwerk G.m.b.H. at Harburg (1.1 million tons); Portland-Zementwerke Obergimpern G.m.b.H. at Obergimpern (550,000 tons); and Sudbayer Portlandzementwerk Gebr. Weisbock & Co., G.m.b.H., at Rohrdorf (1.1 million tons). At least 21 kilns were replaced or removed from production in the country during the year. Nordcement A.G. ceased clinker production at its "Siegfried" plant, Salzderhelden, at yearend, removing 418,000 tons of annual capacity.

Greece.—In February, Chalkis Cement Co. S.A. started clinker production from its new dry-process kiln equipped with a suspension preheater. Annual capacity of the plant at Mikro Vathi, Avlis, was increased by 1.1 million tons to 1.87 million tons. An identical kiln under construction was scheduled for completion by yearend 1975 to bring the plant capacity to a total of 2.97 million tons. In July, ground was broken for General Cement Company's new plant at Methana in eastern Peloponnesus, with annual clinker production capacity of 1.5 million tons; completion was scheduled for yearend 1975. However, construction was suspended because some Government officials considered the plant harmful from an environmental and tourist standpoint. Halyps Cement Co. was installing a new kiln to replace three obsolete kilns at its Aspropyrogo plant in Attica. When completed, annual capacity will be increased by 660,000 tons to 1 million tons. Titan Cement Co. S.A. was constructing a new plant at Kamaris, Bestea, with an annual capacity of 1.1 million tons. Completion was scheduled for late 1975. M.A. Karageorgis S.A. was building a new plant at Messinia, South Peloponnesus, with an annual capacity of 1.1 million tons. The Government has approved the following investments: A $45 million plant in the Arcadia area with a capacity of 1.1 million tons; a $38.5 million plant in Laconia or Arcadia, Peloponnesus, with a capacity of 1 million tons; and an $18.2 million plant in the Preveza area with a capacity of 310,000 tons.

Guatemala.—Cementos Novella S.A. completed its new plant at San Miguel with a 13.6-foot by 195-foot-long dry-process kiln equipped with a four-stage preheater.

Hungary.—Cement es Meszmuvek Vezeriyazgatosaga was replacing five old shaft kilns with two 15-foot-diameter by 263-foot-long dry-process kilns equipped with suspension preheaters at its Hejocsaba plant near Miskolc, completion was scheduled for 1975. Each kiln has a daily capacity of 2,200 tons. Three finish-grinding mills are each 14.5 feet in diameter by 49 feet long with dual drive by two 2,100-kilowatt motors. When completed, it will be Hungary's largest cement works, with an annual capacity of 1.6 million tons of portland cement and portland-blast furnace slag cement. Construction was started at the Balapatfalva plant to increase capacity to 1.2 million tons when completed in 1978.

Iceland.—Although clinker production capacity remained unchanged at 110,000 tons per year, grinding capacity was increased by Sementsverksmidja Rikisins at its Akranes plant to 143,000 tons with the installation of a new mill.

Indonesia.—At least eight new plants and plant expansions including three Governments projects, with combined capacity of 4.4 million tons, were in various stages of planning and construction. P.T. Semen Cibinong experienced delays in construction of its new plant with production capacity of 628,000 tons at Cibinong, West Java, and completion was expected about October 1975. The delays and rapid inflation raised the cost of the plant from $35 million to $41 million. The company plans to increase the annual capacity of this plant to 1.1 million tons by adding a 15-foot-diameter by 220-foot-long dry-process kiln with a preheater. Estimated cost of the expansion was an additional $47.5 million, and completion was scheduled in 1977. P.T. Semen, Indonesia, was constructing a large plant near the site of the Cibinong plant. A joint venture between P.T. Gunung Ngadeg Jaya and Onoda Cement Co. Ltd. of Japan had an application awaiting Government approval to build a cement plant with an annual capacity of 550,000 tons in Cilacap, Central Java, costing $49.5 million. P.T. Semen, Baturaja, was installing a kiln at a new clinker manufacturing plant in Baturaja, South Sumatra, with an annual capacity of 550,000 tons. Two finish-grinding mills, each with a capacity of 275,000 tons, will be installed in the principal marketing areas at Palembang and Telukbetung.

Iran.—Fars & Khuzestan Cement Co. completed its new Abyek plant with an annual capacity of 1.1 million tons. Shemal Cement Co. was planning a new cement plant near Abe-Ali about 28 miles northeast of Teheran. The 15.7-foot-diameter by 243-foot-long dry-process kiln equipped with a suspension preheater will have an annual capacity of 770,000 tons.

Iraq.—The Al Fuota plant about 35

miles west of Baghdad was completed in October with an annual capacity of 220,000 tons. Mosul Cement Public Co. will install a new dry-process kiln at its Bodoosh plant to increase capacity by 550,000 tons. The Government of Iraq was building a new cement plant about 100 miles south of Baghdad that will have an annual capacity of 2.2 million tons when the fourth kiln is completed early in 1978.

Ireland.—At Drogheda, Cement-Roadstone Holdings Ltd. planned to replace the old wet-process plant at its Platin works with an additional dry-process kiln having an annual capacity of 1 million tons. When completed in 1977, the net increase in production capacity will be 550,000 tons.

Italy.—In 1974, Italy became the largest cement-producing country in Western Europe. Cementerie Calabrolucane S.p.A. completed two new plants, each with an annual capacity of 550,000 tons, at Castrovillari and Matera. Cementizillo started operating a new plant at Fanna with a capacity of 495,000 tons. Cementeria e Manufatti Fratelli Colaiacovo Snc. installed a new kiln at its Gubbio plant that increased production capacity by 550,000 tons. Industria Siciliana Cementi S.p.A. increased the capacity of its Modica plant by 132,000 tons with the addition of a new kiln. Cementir-Cementerie del Tirreno S.p.A. was installing a new kiln at its Maddolani plant with an annual capacity of 1,265,000 tons. Completion was scheduled for 1975. S.A.C.C.I. S.p.A. was installing a new kiln at its Castelraimondo plant that will increase annual capacity by 275,000 tons when completed in 1975.

Kenya.—East African Portland Cement Co., Ltd., expanded its Athi River Works capacity with a new kiln. Bamburi Portland Cement Co., Ltd., was installing a new kiln with an annual capacity of 700,000 tons at its Bamburi plant. Completion was scheduled for mid-1976.

Korea, Republic of.—In March, Ssang Yong Cement Industrial Co., Ltd., completed installation of a 19-foot-diameter by 312-foot-long dry-process kiln equipped with a suspension preheater at its Donghae plant. Capacity of the plant was increased by 1.3 million tons to 3.3 million tons. The company embarked on another expansion program to raise the annual capacity of the Donghae plant by 6.1 million tons to a total of 9.5 million tons, one of the world's largest when completed in 1977. New equipment will include four 15.8-foot-diameter by 246-foot-long dry-process kilns with suspension preheaters. Tong Yang Cement Manufacturing Co., Ltd., was increasing the capacity of its Samchuk plant by 1.8 million tons to 2.9 million tons. Completion was scheduled for 1977. Hanil Cement Manufacturing Co., Ltd., was installing a new dry-process kiln utilizing auxiliary burners for precalcination in the suspension preheater at its Tan-yang plant. Capacity will be increased by 1.1 million tons. Hyun Dai Cement Co., Ltd., installed a 16-foot-diameter by 230-foot-long dry-process kiln equipped with a suspension preheater at its Tan-yang plant with a capacity increase of 770,000 tons. Chung Buk Cement Manufacturing Co., Ltd., plans to expand production capacity of its Jechun plant.

Lebanon.—Société des Ciments Libanais increased production capacity of its Chekka plant by 220,000 tons to 1.5 million tons during the year. The company planned to install a new kiln that will increase annual capacity by another 715,000 tons.

Malagasy Republic.—A $23 million cement plant near Antsirabe was planned to be built with Yugoslav-West German cooperative assistance.

Malta.—Hydrocarbon Industries Ltd., Malta Development Corp., and Maltese Falcon Cement Ltd. planned to build a $35 million cement plant with an annual capacity of 365,000 tons in Malta. Completion was scheduled for mid-1978.

Mexico.—Cementos Tolteca S.A. acquired three plants near the Pacific coast during 1973. The company started operating the new kiln at its Atotonilco plant, that increased the annual capacity by 600,000 tons. Cooperativa Manufacturera de Cemento Portland La Cruz Azul S.C.L. completed expansion of its plant at Lagunas, Oaxaca, increasing annual capacity by 330,000 tons. Equipment included a 12.5-foot-diameter by 350-foot-long dry-process kiln with a two-stage preheater. The original kiln was scheduled to be dismantled and the other old kiln, 10 feet in diameter by 360 feet long, will be modernized with installation of a preheater. The company was installing a 17-foot-diameter by 270-foot-long dry-process kiln with a preheater at its plant in Ciudad Cruz Azul, Hidalgo. Completion was scheduled for early 1976. Cementos Anahuac S.A. completed an expansion project at its plant in Tlalnepantla that increased annual production capacity by 700,000 tons. Cementos Apasco S.A. experienced delays in erecting a new kiln at its Apaxco plant because of material shortages. When completed in the spring of 1975, annual capacity of the plant will be increased to 1.5 million tons. Work was continuing under similar difficulties erecting the new 1,320-ton-per-day kiln at the Cementos Veracruz S.A. plant at Orizaba.

Morocco.—Cimenterie Maghrebine, a new company formed as a joint venture between the Moroccan and Algerian Governments, was planning a cement plant with an output of 1 million tons at Oujda.

Mozambique.—Companhia de Cementos de Moçambique ordered equipment for a new plant at Lourenço Marques and for a plant expansion in Beira.

Nepal.—In early 1975, Himal Cement Co., Ltd. planned to start operation of its new wet-process plant with an annual capacity of 66,000 tons at Chobhar. Nepal's Bureau of Mines expected to complete a project report in 1975 for a new cement plant in Bhainse-Hetauda with a production capacity of 220,000 tons.

New Zealand.—New Zealand Cement Holdings Ltd. was installing the third kiln at its Westport plant that will increase production capacity by 165,000 tons when completed in October 1975.

Nigeria.—West African Portland Cement Co., Ld. (WAPCC) started construction of a new cement plant near Shagamu about 40 miles northeast of Lagos with an annual capacity of 650,000 tons. Completion was scheduled for 1976. The Associated Portland Cement Manufacturers Ltd., parent company of WAPCC, together with the Nigerian Government as principal shareholders, were forming a new company to build a cement plant near Ashaka where the railroad crosses the Gongola River about midway between Jos and Maidurgi. The two-kiln, dry-process plant will have an annual capacity of 650,000 tons when completed in 1977.

Oman.—By decree of the Sultan of Oman, a cement plant will be built in that country. Cement Holding A.G. and Associated Portland Cement Manufacturers Ltd. announced plans to erect the country's first cement plant.

Pakistan.—The Iranian Government was assisting in the construction of a cement plant at Kohat, Northwest Frontier Province, with an annual capacity of 300,000 tons.

Panama.—Taiwan Cement Engineering Corp. was building a new plant near Calzada Larga for the Panamanian Government with an annual capacity of 320,000 tons. The name of the new establishment was Empresa Estatal de Cemento "Bayano."

Paraguay.—The Ministry of Industry and commerce was accepting tender proposals to build a plant to supply cement for construction of Itaipu dam, the world's largest hydroelectric project, undertaken jointly by Brazil and Paraguay.

Peru.—On February 12, 1974, the Government of Peru expropriated the country's largest cement producer at Atocongo near Lima and nationalized Cementos Lima S.A.

Philippines.—Midland Cement Corp. built a plant at Bulingbing near Tanay in Rizal Province with a capacity of 600,000 tons. In March, the Holderbank Group acquired an interest in Pacific Cement Co., Inc. The 10-year-old plant at Surigao required considerable rehabilitation.

Portugal.—Companhia de Cimentos do Norte (CINORTE) was building a new plant at Souselas near Coimbra. Combined annual capacity of the two dry-process kilns will be 1.1 million tons when completed in 1975. Two plant expansions were planned for completion in 1976 that would increase the country's annual production capacity by 1.65 million tons: A new kiln at the Alhanda plant by Companhia Cimento Tejo S.A.R.L., and a new kiln at Outao near Setúbal by Secil-Comphania Geral de Cal e Cimento S.A.R.L.

Qatar.—In October, Qatar National Cement Co. completed installation of a new kiln that increased annual capacity by 218,000 tons to 254,000 tons at its plant in Umm-Bab.

Saudi Arabia.—Saudi Cement Co. was installing two new dry-process kilns at its Al Hassa plant between Al Hufut and Abqaiq that will increase annual capacity by 1.1 million tons. In addition, the company was modernizing its three existing kilns.

Singapore.—Ssang Yong Cement, Singapore Cement Manufacturing Co. Pte, Ltd., a joint venture between Ssang Yong Cement Industrial Co., Ltd., of the Republic of Korea and Singapore firms, was installing a 13-foot-diameter by 40-foot-long, 4,000-horsepower finish-grinding mill near deepwater transportation. When completed in late 1975, the plant will become Singapore's fourth clinker-grinding facility. Clinker will be supplied by Ssang Yong's Donghae plant in Korea.

South Africa, Republic of.—Cape Portland Cement Co., Ltd., was increasing the annual output capacity of its De Hoek plant by 500,000 tons. Completion was expected in June 1975. Anglo-Alpha Cement Ltd. planned to install a new kiln at its Dudfield plant to increase daily capacity by 2,200 tons. Completion was scheduled for mid-1977.

Spain.—La Auxiliar de la Construccion S.A. installed a new dry-process kiln at its San Feliu de Llobregat plant near Barcelona with an annual increase in capacity of 660,000 tons. Cementos Molins S.A. completed an expansion program with a new dry-process kiln that increased annual capacity of its San Vicente dels Horts plant by 990,000 tons. S.A. Española de Cementos Portland added a new dry-process kiln to its Yeles plant near Toledo, increasing production capacity by 440,000 tons. Five new kilns were under construction that will increase the country's annual production capacity by 4.1 million tons, as follows: Cia. Valenciana de Cementos Portland S.A. at Factoria "C" Buñol near Valencia (910,000 tons); Cia. Catalana de Cementos Portland S.A. at its Vallirama plant near Barcelona (420,000 tons); Portland Iberia S.A. at its Castillejo plant near Toledo (550,000 tons); Cia. General de Asfaltos y Portland Asland at Sagunto (1.1 million tons); and Uniland at Monjos (1.1 million tons).

Sweden.—A.B. Cement, the country's sole cement producer, was converting its Koping plant with annual capacity of 220,000 tons to manufacturing lime.

Switzerland.—In June, Bundner Cementwerke A.G. completed a new 1,760-ton-per-day kiln at its Untervaz plant, increasing annual capacity to 770,000 tons. Two old kilns will be modernized next year. Société des Chaux et Ciments de la Suisse Romande installed a new kiln with an annual capacity of 545,000 tons at its Eclepéns plant, increasing plant capacity by 187,000 tons. Two old kilns were transferred to reserve, and an old kiln at the Roche plant was permanently abandoned. A new kiln at the Siggenthal plant increased Portland-Cement-Werk Wuerenlingen-Siggenthal A.G. production capacity by 407,000 tons. In the spring, Cementfabric Holderbank started construction of a new plant at Rekingen-Mellikon, Aargau. The kiln with an annual capacity of 770,000 tons was scheduled for operation in spring 1975.

Tanzania.—The State Mining Corp. was seeking bids to build the country's second cement plant to be located near Tanga. Initial capacity of the plant is to be 275,000 tons, and completion was planned for 1977. A Yugoslav company is involved in the planning, and Tanzania was expecting Yugoslav-West Germany cooperative assistance. Plans were also made to expand the capacity of the Wazo Hill plant and build another new plant in Mbeya.

Taiwan.—Kvan Hsi Cement Corp. plans to establish a new cement plant near Kaohsiung with an annual capacity of 1.3 million tons. Cheng Tai Cement Corp. was expanding production capacity of its plant at Tsoying with addition of a 13.5-foot-diameter by 195-foot-long dry-process kiln equipped with a suspension preheater. Completion was scheduled for mid-1975. Chia Hsin Cement Corp. was installing a 15-foot-diameter by 220-foot-long dry-process kiln equipped with a suspension preheater. The additional production capacity was expected to be in operation by fall 1975.

Tunisia.—The Tunisian Government planned to build a new plant with an annual capacity of 770,000 tons at Gabes. It also reached an agreement in principle with the Algerian Government for a joint venture to build a cement plant with an annual capacity of 1 million tons at Thala near the Algerian border. Ciments Portland de Bizerte was planning to expand the capacity of its Bizerte plant by 71,000 tons.

Turkey.—Bolu Çimento Sanayii A.S. started operating its new plant near Bolu with an annual capacity of 550,000 tons. Unye Çemento A.S. completed its new plant at Ordu with production capacity of 550,000 tons. Nuh Çimento Sanayii A.S. installed a new kiln at its Hereke plant near Istanbul that increased the annual capacity by 440,000 tons. Mersin Çimento A.S. was constructing a plant at Mersin with an annual capacity of

1.1 million tons. Completion was scheduled for 1975. Akcimento Ticaret A.S. was installing a kiln at its plant near Istanbul, to increase production capacity by 550,000 tons when completed in 1975. Nidge Çimento Sanayii A.S. also expected to complete construction of a new kiln at its Nidge plant in 1975, to increase annual capacity by 300,000 tons. Five new plants were planned or under construction with completion expected in 1976 or 1977: Masiin Çemento A.S. at Aardin (580,000 tons), and Turkiye Çimento Sanayii A.S. near Kars (290,000 tons), Yozgat, Iskanderun, and Canakkale. Aslan ve Eskihisir Muttehit Çimento ve su Kireci Fabrikasi A.S. was installing a new kiln to double production capacity of its plant near Darica to 1.1 million tons when completed in 1977. The five new plants and nine plant expansions were expected to increase the country's production capacity to 19.1 million tons when completed by 1977.

United Arab Emirates.—Union Cement Co. was building a plant in Ras al-Khaimah with an annual capacity of 275,000 tons. Completion was scheduled for spring 1975. Norcem of Norway was providing technical assistance and will be responsible for operating the new plant. Sheikl Rashid planned to build a cement plant near Dubai with a capacity of 550,000 tons.

United Kingdom.—Aberthaw & Bristol Channel Portland Cement Co., Ltd., was installing a new kiln at its Aberthaw plant, to increase annual capacity by 330,000 tons when completed in 1975. A new kiln was under construction at the Ribblesdale Cement Ltd., plant in Clitherol, Lancashire, to increase production capacity by 363,000 tons; completion was scheduled for 1975.

Upper Volta.—Société Voltaique was building a clinker-grinding facility near Ougadougou with an annual capacity of 33,000 tons.

Venezuela.—C.A. Venezolana de Cementos increased the capacity of its Pertigalete plant to 1.8 million tons and was installing an additional 13.5 foot/12-foot-diameter by 450-foot-long wet-process kiln. The company was installing a 12-foot-diameter by 450-foot-long wet-process kiln at its Maracaibo plant that will increase annual capacity by 750,000 tons. C.A. Fabrica Nacional de Cementos was installing two grinding mills at its Ocumare plant: 13-foot-diameter by 37.5-feet-long, and 15-foot diameter by 44.5 feet long.

Yugoslavia.—Salonit Anhovo Industrija Gradbenega Materiala was expanding production capacity of its plant near Novo Gorica by 935,000 tons to 1.1 million tons.

Table 22.—Hydraulic cement: World production, by country
(Thousand short tons)

Country	1972	1973	1974 p
North America:			
Bahamas	1,087	1,051	875
Canada (sold or used by producers)	9,976	11,126	11,308
Costa Rica	288	300	328
Cuba	1,625	r e 1,650	e 1,650
Dominican Republic	746	636	667
El Salvador	240	265	321
Guatemala	291	342	342
Haiti	89	119	157
Honduras	214	259	237
Jamaica	460	444	440
Mexico	9,482	10,788	11,572
Nicaragua	130	212	260
Panama	r 299	478	435
Trinidad and Tobago	316	273	266
United States (including Puerto Rico)	84,556	87,573	82,888
South America:			
Argentina	6,002	5,711	5,944
Bolivia	166	184	223
Brazil	12,545	14,769	16,446
Chile	r 1,524	1,519	1,571
Colombia	r 3,366	3,623	3,840
Ecuador	r 531	535	e 535
Paraguay	79	80	114
Peru	1,793	1,920	2,097
Surinam	62	r e 65	e 70
Uruguay	513	570	603
Venezuela	8,287	8,762	8,851

See footnotes at end of table.

Table 22.—Hydraulic cement: World production, by country—Continued

(Thousand short tons)

Country	1972	1973	1974 [p]
Europe:			
Albania [e]	[r] 440	[r] 440	440
Austria	[r] 6,994	6,900	7,082
Belgium	7,815	7,761	8,196
Bulgaria	4,310	4,605	4,738
Czechoslovakia	8,868	9,238	9,883
Denmark	3,167	3,183	2,747
Finland	[r] 2,187	2,342	2,428
France	[r] 32,973	33,855	35,794
Germany, East	9,763	10,525	11,133
Germany, West	47,559	45,208	39,658
Greece	[r] 6,924	7,158	7,729
Hungary	3,273	3,757	3,789
Iceland	148	148	111
Ireland	1,619	1,852	[e] 1,780
Italy	[r] 36,884	40,027	40,024
Luxembourg	341	394	431
Netherlands	4,435	4,494	4,506
Norway	[r] 3,008	2,986	2,932
Poland	15,417	17,139	18,480
Portugal [1]	[r] 3,064	3,639	3,632
Romania	10,154	10,856	12,340
Spain (including Canary Islands)	[r] 21,579	24,524	26,081
Sweden	[r] 4,268	4,645	3,663
Switzerland	[r] 6,298	6,345	5,790
U.S.S.R	114,970	120,703	126,766
United Kingdom	19,894	22,031	19,600
Yugoslavia	6,339	7,028	7,327
Africa:			
Algeria	1,023	1,122	[e] 1,160
Angola	688	847	[e] 860
Cameroon	187	212	222
Cape Verde Islands	9	[e] 11	[e] 11
Egypt	4,213	3,987	3,483
Ethiopia	207	225	229
Gabon	NA	NA	88
Ghana	454	481	[e] 500
Ivory Coast	[r] 661	733	[e] 730
Kenya	882	873	944
Liberia	100	[e] 100	[e] 100
Libya	67	87	313
Malagasy Republic	71	77	67
Malawi	82	94	89
Morocco	1,700	1,785	2,110
Mozambique	516	674	513
Niger	36	[e] 39	23
Nigeria	[r] 1,260	1,347	1,329
Rhodesia, Southern	690	742	[e] 770
Senegal	369	326	366
South Africa, Republic of	[r] 6,737	7,566	8,048
Sudan	175	229	331
Tanzania	261	346	326
Togo	128	126	141
Tunisia	[r] 690	583	572
Uganda	183	158	170
Zaire	525	592	[e] 610
Zambia	534	454	[e] 420
Asia:			
Afghanistan [2]	109	155	161
Bangladesh	25	34	98
Burma	[r] 220	213	190
China, People's Republic of [e]	[r] 25,350	[r] 27,560	29,760
Cyprus	[r] 466	497	373
Hong Kong	450	486	629
India	[r] 17,368	16,541	15,722
Indonesia	657	805	911
Iran	[r] 3,717	3,846	[e] 4,300
Iraq [e]	2,100	2,000	2,000
Israel	1,703	1,387	1,551
Japan	[r] 73,074	86,110	80,592
Jordan	730	680	657
Khmer Republic	[r] 58	86	[e] 110
Korea, North [e]	5,800	6,400	6,600
Korea, Republic of	7,150	9,011	9,747
Lebanon	[r] 1,858	1,829	1,922
Malaysia	1,279	1,409	1,501
Mongolia	155	161	[e] 165
Pakistan	[r] 2,872	3,169	3,879
Philippines	3,200	4,474	3,861
Qatar [e]	[r] 110	[r] 110	110
Ryukyu Islands	[e] 280	(3)	(3)

See footnotes at end of table.

Table 22.—Hydraulic cement: World production, by country—Continued

(Thousand short tons)

Country	1972	1973	1974 [p]
Asia—Continued			
Saudi Arabia	[r] 1,063	1,111	[e] 1,160
Singapore	1,112	1,133	[e] 1,160
Sri Lanka	422	507	522
Syrian Arab Republic	1,107	935	1,043
Taiwan	[r] 6,469	6,720	6,802
Thailand	[r] 3,724	4,085	4,325
Turkey	9,286	9,848	9,862
Vietnam, North [e]	280	550	660
Vietnam, South	268	292	[e] 110
Yemen Arab Republic	NA	13	40
Oceania:			
Australia	[r] 5,442	5,784	5,788
Fiji Islands	99	101	94
New Zealand	[r] 992	1,166	1,225
Total	[r] 723,796	773,061	776,210

[e] Estimate. [p] Preliminary. [r] Revised. NA Not available.

[1] Includes production from the Azores and Madeira Islands as follows, in thousand short tons: 1972: Azores—17, Madeira—33; 1973: Azores—22, Madeira—35; 1974: Azores—15, Madeira—34. The balance of output in each year was from continental Portugal.

[2] Year beginning March 21 of that stated.

[3] Included with Japan.

TECHNOLOGY

Fossil fuel energy consumed by the cement industry to produce 1 ton of clinker ranged from 3.5 million Btu to 11.8 million Btu and averaged 6.26 million Btu. An additional 1.39 million Btu in electrical energy (130 kilowatt-hours per ton) was required in the production of 1 ton of portland cement, mostly for grinding.[4] The total energy used to produce 1 ton of portland cement averaged 7.65 million Btu. The fuel cost of producing 1 ton of clinker at an inefficient wet-process plant was more than three times the fuel cost for an efficient dry-process plant.

Shortages of natural gas and fuel oil and sharp increases in coal and other fuel costs, particularly imported fuel oil, which quadrupled in cost, have impelled virtually all cement manufacturers to consider improving kiln thermal efficiency. Most of the significant advances in cement production technology have been made in Europe and Japan. While the cement industry in the United States was seeking ways to reduce labor costs by modernization and automation in the 1950's, European manufacturers were developing means to reduce fuel costs. The dry-process kiln with a four-stage suspension preheater first developed by Humboldt in West Germany in 1950 offered the best fuel economy. F.L. Smidth of Denmark and Polysius Corp., Humboldt Wedag, Krupp, and Buhler-MIAG of West Germany all developed four-stage suspension preheaters, all of which are available in the United States from equipment manufacturers. Where alkali in raw materials is a serious problem, dry-process kilns with two-stage and single-stage suspension preheaters are used, with reduced fuel efficiency but greater economy than the long dry-process kilns and wet-process kilns.

Japanese firms with license rights on West German four-stage suspension preheaters developed auxiliary burners in the preheater to increase calcination to about 90% to 95% prior to the feed entering the kiln. An important advantage of this process, in addition to improved fuel economy, is that kiln output can be increased. Two equipment manufacturers in the United States were negotiating licensing agreements with Japanese firms holding patents on the new process. National Cement Co., Inc., was the first company in the United States to try the new Japanese process. The company started cutting an old kiln approximately in half and installing a four-stage suspension preheater with auxiliary burners. When completed, the output of the kiln will be more than doubled, and fuel consumption will be reduced to less than 3 million Btu per ton. In terms of thermal efficiency, this will be the best in the United States and equal to many operating in Europe and Japan. Kiln units exceeding 8,000 tons per day in output were in operation, and it may be possible to attain 10,000 tons per day using the Japanese process.

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[4] Based on information from the Energy Research and Development Administration. The Federal Power Commission calculated an average heat rate of 10,660 Btu per net kilowatt-hour from national average heat rates for fossil-fueled steam-electric plants (130 kwh/ton x 10,660 Btu/kwh=1,385,800 Btu/ton).

Some companies modified old kilns by enlarging the diameter of the feed end to permit a greater quantity of chains or other heat exchanger devices to reduce fuel consumption and increase output. Efficiency of wet-process kilns can be improved by the use of slurry thinner additives that reduce the viscosity of the slurry so that a feed with higher solids and lower water can be pumped into the kiln. In one instance, a 2% water reduction was achieved, accounting for a 7.5% decrease in Btu per ton consumption. At another plant, a water reduction of 3.3% was made, using a slurry thinner additive, with a corresponding 5.2% reduction in Btu per ton requirements.

In instances where certain raw materials require wet grinding, the slurry has been dried outside the kiln, using waste heat from kiln exhaust gases in a spray dryer. Use of the spray dryer in Denmark resulted in up to 30% increase in output and up to 12.5% lower fuel consumption.

In addition to utilization of heat from dry-process kiln exit gases in suspension preheaters, waste heat was used for drying raw materials and coal. The roller mill was becoming increasingly important in dry-process raw grinding because it was more amenable to combined grinding-drying than ball and rod grinding mills. The development of hydraulically loaded rollers, rather than spring-loaded rollers, made possible larger capacity roller mills. The roller mill can dry raw materials with 15% moisture, using kiln gas, while the maximum moisture that can be dried in a ball mill is 7%. Roller mills will grind feed from 2 to 5 inches in size, depending on mill size, compared with about minus ½ to ¾ inch for the ball mills. Horsepower requirements for roller mills are 70% to 80% of the requirements for ball mills. Roller mills operate at a much lower noise level than ball mills. Cost of roller wear is about 60% of the cost of ball mill media. In 1973, Flintkote installed the first roller mill in the United States at Glens Falls, N.Y. The 1,500-horsepower mill had an hourly capacity of 125 tons.

In 1974, four roller mills were installed: Medusa Cement Co. at Clinchfield, Ga.; Southwestern Portland Cement Co. at Fairborn, Ohio; Universal Atlas Cement Div. at Buffington, Ind.; and Illinois Cement Co. at La Salle, Ill. Four more roller mills were being installed for operation in 1975: Capitol Aggregates, Inc., at San Antonio, Tex.; Universal Atlas Cement Div. at Leeds, Ala.; Citadel Cement Corp. at Roanoke, Va.; and Kaiser Cement & Gypsum Corp. at San Antonio, Tex. Hourly capacities of the roller mills ranged from 90 to 165 tons with various horsepower requirements from 900 to 1,500. Maximum moisture dried ranged from 4% to 15%, and the maximum feed material size ranged from 2 to 4 inches.

Several companies were manufacturing portland pozzolan cement to reduce the fuel costs in producing cement. Fly ash, a waste product from burning coal, was interground with portland cement clinker replacing about 20% of the clinker. Basically a 20% reduction of fuel consumption was accomplished.

In 1959, the first cyclone-gravel bed filter system for removing dust particles from air discharged from clinker coolers was installed in West Germany. Since 1973, 6 U.S. companies have installed gravel bed filter systems, or have them in various stages of planning and construction, at 14 plants. Each installation consists of several equal-sized units connected by ducts. Hot discharge air from clinker coolers enters a primary chamber where velocity is reduced to remove coarse dust. Additional coarse dust is removed in a cyclone preseparator. Fine dust is collected on a horizontally arranged 4-inch-thick filter bed, consisting of uniform quartz grains about the size of No. 3 shot. Periodically, the filter media is automatically air-cleaned of entrained dust. Clinker dust collected is recovered. Reported advantages of the gravel bed dust collector are (1) the filter medium resists wear, (2) maintenance costs are low, (3) temperatures to 900° F and above can be withstood, (4) a relatively wide variation in dust particle size will not affect filter performance, (5) water spray systems are not required, and (6) no filter replacement is required. Performance of cyclone-gravel bed dust collectors meets Federal standards under the Clean Air Act that limit discharge of particulate matter from clinker coolers to 0.10 pound per ton of dry kiln feed.

Another innovation in clinker cooler dust abatement was developed in 1973, by Riverside Cement Co., at Victorville, Calif., and approved by Government pollution control agencies in 1974. A heat exchanger system was utilized that serves both as an air pollution control device and as a method of heat recovery for secondary kiln air. Establishing a closed system of air circulation through the clinker cooler rather than ventilating hot dusty air to the atmosphere, the air-to-air heat exchanger engineered by Smith Environmental Corp., El Monte. Calif., eliminates the need for a baghouse or other kind of dust collector. Hot dusty air from the clinker passes through cyclones to remove coarse dust, then into heat exchanger tubes and back to the cooler. Temperature of the hot air is reduced in the heat exchanger from 600° F to 200° F by atmospheric air flowing over the outside of the tubes carrying the heated air. Clinker dust accumulated at the bottom of the heat exchanger is recovered by a system of gravity tipping valves and a screw conveyor. Reported advantages of this system include (1) substantially lower capital expense, (2) lower maintenance cost, (3) lower power cost (a 75-horsepower reduction in exhaust fan requirements at a cost of $150 a year per horsepower is a savings of $10,750), and (4) a kiln fuel savings from use of 200° F secondary combustion air.

Chromium

By John L. Morning [1]

Strong demand and rising prices for chromium marked the year. Demand for chromium alloys established a record high, although consumption decreased in the fourth quarter. The chemical industry registered new highs in consumption of chromite and production of sodium bichromate. Rising chromite prices, removal of price controls, and high demand for chromium alloys brought numerous price changes during the year. Depending on the particular alloy, prices increased twofold to threefold.

Table 1.—Salient chromite statistics
(Thousand short tons)

	1970	1971	1972	1973	1974
United States:					
Exports	41	35	20	21	18
Reexports	78	145	57	34	99
Imports for consumption	1,405	1,299	1,056	931	1,102
Consumption	1,403	1,093	1,140	1,387	1,447
Stocks Dec. 31: Consumer	733	1,019	857	597	573
World: Production	6,672	7,093	r 6,725	r 7,414	7,931

r Revised.

Legislation and Government Programs.—Government chromium material inventories are shown in table 2. Included in the inventories is material sold but unshipped. This includes chemical-grade chromite, 205,000 tons; refractory-grade chromite, 583,000 tons; metallurgical-grade chromite 909,000 tons; and chromium metal, 365 tons.

During the year, the General Services Administration (GSA), under various disposal programs, sold 318,138 tons of chemical-grade chromite, 899,950 tons of metallurgical-grade chromite, 571,241 tons of refractory-grade chromite, and 3,194 tons of chromium metal. The metallurgical sale was the Government stockpile at Nye, Mont., acquired under the Defense Production Act, primarily during the 1950's. At yearend, no material was available for sale from Government stockpiles because congressional authorization is required for further disposal of excess chromium materials. Although GSA proposed various programs, no congressional action was taken.

Table 2.—U.S. Government chromium stockpile material inventories and objectives
(Thousand short tons)

	Objective	Inventory by program, Dec. 31, 1974			
		National stockpile	Defense Production Act	Supplemental stockpile	Total
Chromite, chemical-grade	8	412	--	42	454
Chromite, metallurgical-grade	445	2,189	901	323	3,413
Chromite, refractory-grade	54	818	--	165	983
Ferrochromium, high-carbon	11	126	--	277	403
Ferrochromium, low-carbon	--	128	--	191	319
Ferrochromium-silicon	--	26	--	33	[1] 58
Chromium metal	--	--	--	4	4

[1] Data may not add to total shown because of independent rounding.

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[1] Supervisory physical scientist, Division of Ferrous Metals.

Deliveries of chromite from Government stockpiles from current- or prior-year sale contracts were as follows: Chemical-grade chromite, 299,493 tons, metallurgical-grade chromite, 76,735 tons; refractory-grade chromite, 123,921 tons; and chromium metal, 3,020 tons.

Repeal of the Byrd Amendment, which allows chromium to be imported into the United States from Southern Rhodesia, was the subject of congressional debate throughout the year. The Senate passed a bill early in the year that essentially repealed the Byrd Amendment. In the House of Representatives, floor votes were repeatedly scheduled and then dropped. At yearend, the bill was withdrawn. At the start of the 94th Congress in 1974, the bill was reintroduced.

In October, the Environmental Protection Agency (EPA) proposed air quality standards for the ferroalloy industry. For chromium alloy production, a maximum pollution level of 0.51 pound of particulate per megawatt-hour would be established.

Considerable interest was shown in mineral economic stockpiles. During the 93d Congress, Representative Bennett, Chairman of the Seapower and Strategic and Critical Materials Subcommittee of the House Armed Services Committee, offered an economic materials stockpile bill.

The Secretary of the Interior advocated holding several years' supply of most strategic minerals, including chromium, in ready reserve stocks. The stockpiles would not be long-run solutions to mineral problems, but would be used as a bridge to get over a temporary situation.

Assistant Secretary of State for Economic and Business Affairs, Thomas Enders, testified before Congress that chromium, bauxite, and platinum were prime candidates for potential economic stockpiles. He also cautioned that there were serious problems associated with economic stockpiles that would have to be worked out. Early in 1975, the Ferroalloys Association recommended to Congress a long-term strategic metals stockpile policy for the United States.

A comprehensive study by EPA and The Ferroalloys Association on air pollution engineering and costs in the ferroalloy industry was published.[2] The study encompassed historical background, current uses and production, and future trends as well as ferroalloy manufacture, atmospheric emissions, description of control systems, emission control guidelines, economics of emission control, and recommended research and development programs.

Concern over the ability of the United States to secure adequate supplies of imported critical raw materials at reasonable prices resulted in a special task force to identify and assess potential threats to supplies of these commodities as a basis for effective policy decisions. The results of the study, which included chromium, was published late in the year.[3]

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[2] Dealy, J. O. and A. M. Killin. Engineering and Cost Study of the Ferroalloy Industry. Environmental Protection Agency (EPA–450/2–74–008), May 1974, 403 pp.

[3] Council on International Economic Policy. Special Report, Critical Imported Materials. December 1974, 110 pp.

DOMESTIC PRODUCTION

Domestic mine production of chromite ceased in 1961 when the last Government Defense Production Act contract was phased out. However, the United States continued to be one of the world's leading chromite consumers in producing chromium alloys, refractories, and chemicals. The principal producers of these products were as follows:

Company	Plant
Metallurgical industry:	
Airco Alloys and Carbide Div., Air Deduction Co. Inc	Calvert City, Ky. Niagara Falls, N.Y. Charleston, S.C.
Chromium Mining & Smelting Corp	Woodstock, Tenn.
Foote Mineral Co	Keokuk, Iowa Graham, W.Va.
Interlake, Inc	Beverly, Ohio
Prairie Metals and Chemicals, Inc	Prairie, Miss.
Satralloy Corp	Alloy, W.Va.
Shieldalloy Corp., Division of Metallurg Inc	Newfield, N.J.

Company	Plant
Metallurgical industry:—Continued	
Union Carbide Corp	Niagara Falls, N.Y. Marietta, Ohio Alloy, W.Va.
Refractory industry:	
Basic, Inc	Maple Grove, Ohio
Corhart Refractories Co., Inc	Louisville, Ky. Pascagoula, Miss.
General Refractories Co	Baltimore, Md. Lehi, Utah
Harbison-Walker Refractories Co. (a division of Dresser Industries, Inc.)	Hammond, Ind. Baltimore, Md.
Kaiser Aluminum & Chemical Corp	Moss Landing, Calif. Columbiana, Ohio Plymouth Meeting, Pa.
North American Refractories Co	Womelsdorf, Pa.
Ohio Fire Brick Co	Jackson, Ohio
Chemical industry:	
Allied Chemical Corp	Baltimore, Md.
Diamond Shamrock Corp	Castle Haynes, N.C. Kearny, N.J.
PPG Industries, Inc	Corpus Christi, Tex.

Table 3.—Production, shipments, and stocks of chromium ferroalloys and chromium metal

(Short tons)

Alloy	Production		Shipments	Producer stocks Dec. 31
	Gross weight	Chromium content		
1973:				
Low-carbon ferrochromium	86,958	60,917	103,444	9,343
High-carbon ferrochromium	234,102	158,550	251,954	20,475
Ferrochromium-silicon	78,992	29,071	88,921	7,177
Other [1]	17,693	11,505	18,040	2,046
Total	417,745	260,048	462,359	39,041
1974:				
Low-carbon ferrochromium	86,912	60,706	93,316	3,047
High-carbon ferrochromium	214,521	144,910	228,425	13,647
Ferrochromium-silicon	97,359	35,096	101,540	2,519
Other [1]	28,639	16,907	32,101	1,417
Total	427,431	257,619	455,382	20,630

[1] Includes chromium briquets, chromium metal, exothermic chromium additives, and other miscellaneous chromium alloys.

CONSUMPTION AND USES

Domestic consumption of 1,447,000 tons of chromite ore and concentrate containing about 438,000 tons of chromium was 4% higher than in 1973. Of the total chromite consumed, the metallurgical industry used 62.3%, the refractory industry 20.3%, and the chemical industry 17.4%. The metallurgical industry consumed 902,000 tons of chromite containing 290,000 tons of chromium in producing 427,431 tons of chromium alloys and metal. About 66.9% of the metallurgical-grade ore had a chromium-to-iron ratio of 3:1 and over, 14.0% had a ratio between 2:1 and 3:1, and 19.1% had a ratio of less than 2:1.

Producers of chromite-bearing refractories consumed 294,000 tons of ore containing about 71,000 tons of chromium. The chemical industry consumed 251,000 tons of chromite containing about 77,000 tons of chromium in producing 174,000 tons of chemicals (sodium bichromate equivalent).

Chromium has a wide range of applications in three consuming industries. In the metallurgical industry, its principal use is in stainless steel. Primarily because of a record year in manufacture of stainless steel, consumption of chromium alloys reached a record high of 585,000 tons. Stainless steel accounted for 75% of the total chromium alloys consumed, an increase of 65,000 tons compared with that of 1973.

In the refractory industry, chromium was used in the form of chromite primarily for the manufacture of refractory bricks to line metallurgical furnaces. Consumption of chromite for refractory purposes increased 13% compared with that of 1973.

The chemical industry consumes chromite for manufacturing sodium or potassium bichromate, the base material for a wide range of chromium chemicals. Chromite consumption in this industry increased 22% compared with that of 1973.

Table 4.—Consumption of chromite and tenor of ore used by primary consumer groups in the United States

Year	Metallurgical industry		Refractory industry		Chemical industry		Total	
	Gross weight (thousand short tons)	Average Cr_2O_3 (Percent)	Gross weight (thousand short tons)	Average Cr_2O_3 (Percent)	Gross weight (thousand short tons)	Average Cr_2O_3 (Percent)	Gross weight (thousand short tons)	Average Cr_2O_3 (Percent)
1970	912	48.0	278	35.9	213	45.3	1,403	45.2
1971	720	47.8	193	36.3	180	45.6	1,093	45.4
1972	727	47.9	224	35.9	189	45.7	1,140	45.2
1973	920	48.1	261	35.0	206	45.3	1,387	45.2
1974	902	47.0	294	35.2	251	44.8	1,447	44.3

Table 5.—U.S. consumption and consumer stocks of chromium ferroalloys and metal, in 1974

(Short tons, gross weight)

	Low-carbon ferrochromium	High-carbon ferrochromium	Ferrochromium silicon	Other	Total
End use:					
Steel:					
Carbon	986	2,601	512	615	4,714
Stainless and heat-resisting	142,479	208,644	87,000	237	438,360
Full alloy	18,772	47,149	5,025	5,622	76,568
High-strength low-alloy and electric	3,163	8,776	2,434	2,742	17,115
Tool	2,019	5,035	282	71	7,407
Cast irons	1,300	8,157	224	791	10,472
Superalloys	5,980	8,334	509	2,583	17,406
Alloys (exclude steels and superalloys):					
Welding and alloy hard-facing rods and materials	858	878	--	338	2,069
Other alloys [1]	1,579	1,246	15	2,122	4,962
Miscellaneous and unspecified	3,408	1,019	69	1,705	6,201
Total	180,544	291,834	96,070	[2] 16,826	585,274
Chromium content	123,424	188,728	37,033	10,755	359,940
Stocks Dec. 31, 1974	14,937	25,280	10,227	[3] 3,303	53,747

[1] Includes magnetic and nonferrous alloys.
[2] Includes 5,479 tons of chromium metal.
[3] Includes 1,090 tons of chromium metal.

STOCKS

Chromite stocks which decreased significantly in the 2 previous years decreased only 4% in 1974 despite the unprecedented demand for chromium. Metallurgical industry stocks remained at the same level as in the previous year, refractory industry stocks increased nearly 10%, and those in the chemical industry decreased 38%. Shipping problems, both rail and port loading, in southern Africa along with a record consumption year caused the drop in stocks in the chemical industry. At yearend, stocks represented about a 5-month supply in the metallurgical industry, a 7-month supply in the refractory industry, and a 3-month supply in the chemical industry.

Primarily because of record stainless steel production, producer stocks of chromium alloys decreased 47% and consumer stocks increased 11%.

Stocks of chromium chemicals (sodium bichromate equivalent) at producer plants increased from 6,858 tons in 1973 to 14,525 tons in 1974. Stocks in general were at a low level throughout the year, but rose sharply in last 2 months of the year.

Table 6.—Consumer stocks of chromite, Dec. 31

(Thousand short tons)

Industry	1970	1971	1972	1973	1974
Metallurgical	387	667	601	339	340
Refractory	235	233	160	154	169
Chemical	111	119	96	104	64
Total	733	1,019	857	597	573

PRICES

The year was marked by steeply rising prices both for chromite and for chromium alloys. The published Soviet chromite price began the year at $37–$39 per metric ton f.o.b. Black Sea ports and moved higher in March to $53–$58 per metric ton. Turkish ore was quoted at $37 per long ton delivered Atlantic ports in January, and shortly thereafter moved to $50 per long ton f.o.b. Turkey. At midyear, the price rose to $60 per ton and in September, to $65 per long ton. South African ore began the year at $33–$34 per long ton delivered Atlantic ports and moved quickly to $37–$42 per ton. In March, the price was extended to $37–$44 per long ton. At midyear, the price was requoted at $50–$60 per ton, but in September the price was lowered to $47–$52 per long ton for the balance of the year.

Domestic chromium alloy prices began the year under regulation by the Cost of Living Council. Prices of imported chromium alloys at the beginning of the year were lower than domestic prices, but in the first quarter of the year rapidly increased by 4 to 5 cents per pound of chromium higher than domestic material. Domestic low-carbon prices were increased in February. After the Cost of Living Council deregulated ferroalloy prices in March, domestic producers increased most chromium alloy prices to about that of imported alloys. Throughout the balance of the year, numerous price changes were announced for both domestic and imported chromium alloys with imported alloys generally leading the change and at substantially higher prices than for domestic alloys. Prices of chromium alloys in January and December were as follows:

Material	*Cents per pound of chromium*	
	Jan. 1, 1974	Dec. 31, 1974
U.S. charge chromium	22–28	50
U.S. high-carbon ferrochromium	28.7	54
Imported charge chromium	21–21.5	65–75
U.S. low-carbon ferrochromium (0.05% carbon)	85.0	100
Imported low-carbon ferrochromium (0.05% carbon)	84.0	140–148
Simplex	([1])	85
	Cents per pound of product	
Aluminothermic chromium metal	153	230
Electrolytic chromium metal	153	230

[1] Not quoted.

Source: Metals Week.

FOREIGN TRADE

Exports of chromite were about the same as in 1973, but reexports increased nearly threefold compared with those of 1973. Major export shipments were to Canada (71%), Mexico (8%), Venezuela (8%), Australia (6%), and Peru (6%). Small quantities were shipped to three other countries. Reexports were shipped to four countries: Mexico (46%), Canada (43%), and Sweden (10%) received most of the shipments.

Ferrochromium exports to 17 countries decreased 52% compared with 1973 to 7,245 tons valued at $3,765,000. Canada

(50%), Mexico (28%), and West Germany (8%) were the leading recipients of the shipments.

Chromium and chromium alloys (wrought and unwrought) and waste and scrap exports totaled 1,251 tons valued at $2,258,000. Of the 30 countries receiving shipments, Brazil accounted for 27%, Canada, 12%, the United Kingdom, 11%, Argentina, 5%, the Netherlands, 5%, and West Germany, 5%.

Exports of pigment-grade chromium chemicals totaled 217 tons valued at $506,000. Canada (44%), the United Kingdom (24%), and Australia (15%) received 83% of the shipments; the balance was dispersed among 19 other countries. Exports of non-pigment-grade chemicals totaled 2,657 tons valued at $3,630,000. Canada received 28%, Australia, 15%; the Republic of Korea, 10%; and 38 countries received the balance.

Exports of sodium dichromate decreased 15% compared with that of 1973, falling to 10,550 tons valued at $3,284,000. Canada was the leading recipient with 51% of the shipments, and 35 other countries accounted for the balance.

Imports of chromite in 1974 increased 18% in quantity and 36% in value compared with 1973 totals. Imports increased 39% from the Philippines, 23% from the U.S.S.R., and 13% from the Republic of South Africa, and decreased 8% from Turkey.

Imports of ferrochromium established a new yearly record of 161,573 tons, an increase of 4% over that of 1973. The Republic of South Africa supplied 43% and Japan supplied 15% of the low-carbon ferrochromium imports. Eight other countries supplied the balance. High-carbon ferrochromium was imported from the Republic of South Africa (38%), Southern Rhodesia (25%), Yugoslavia (18%), and Brazil (9%). The balance was supplied by eight other countries.

Ferrochromium-silicon imports decreased 42% to 7,553 tons valued at $2,045,000. The Republic of South Africa supplied 56% and Southern Rhodesia, 44% of the total.

Chromium carbide imports totaling 233 tons, valued at $1,132,000, decreased 24%. West Germany supplied 70% and the United Kingdom and Japan supplied the balance.

Imports of chromium metal, unwrought and waste and scrap, decreased to 1,960 tons valued at $5,388,000 from 2,690 tons valued at $6,080,000 in 1973. Of the seven countries supplying imports, the United Kingdom accounted for 56% and Japan, 32%.

Imports of chromium-containing pigments were as follows: Chrome green, 45 tons; chrome yellow, 4,360 tons; chromium oxide green, 504 tons; molybdenum orange, 477 tons; and zinc yellow, 1,832 tons. Total value of these products was $8.2 million. Chrome yellow accounted for 52% and zinc yellow for 24% of total value. The leading suppliers were Japan (41% of total value) and Canada (27% of the total value).

Sodium chromate and dichromate imports totaled 1,945 tons valued at $1,132,000, nearly doubling those of 1973. Of the nine countries supplying imports, Japan accounted for 55%; Taiwan, 14%; and Canada, 11%. Imports of potassium chromate and dichromate increased significantly to 456 tons valued at $345,000 compared with 6 tons in 1973. Japan supplied 99% of the total and three other countries supplied the balance. Strontium chromate received from five countries totaled 407 tons valued at $662,000. Canada supplied 76% of the total.

Table 7.—U.S. exports and reexports of chromite ore and concentrates
(Thousand short tons and thousand dollars)

Year	Exports		Reexports	
	Quantity	Value	Quantity	Value
1972 ----	20	824	57	1,946
1973 ----	21	789	34	989
1974 ----	18	1,430	99	3,101

Table 8.—U.S. imports for consumption of chromite, by grade and country

(Thousand short tons and thousand dollars)

Country	Not more than 40% Cr_2O_3			More than 40% but less than 46% Cr_2O_3			46% or more Cr_2O_3			Total		
	Gross weight	Cr_2O_3 content	Value	Gross weight	Cr_2O_3 content	Value	Gross weight	Cr_2O_3 content	Value	Gross weight	Cr_2O_3 content	Value
1973:												
Guatemala	--	--	--	(1)	(1)	1	--	--	--	(1)	(1)	1
Pakistan	--	--	--	--	--	--	22	11	862	22	11	862
Philippines	186	62	4,263	--	--	--	4	3	100	190	65	4,363
Rhodesia, Southern	--	--	--	--	--	--	43	21	1,483	43	21	1,483
South Africa, Republic of	5	2	58	264	118	3,430	34	16	593	303	136	4,081
Turkey	11	4	319	37	16	1,063	83	39	2,827	131	59	4,209
U.S.S.R	28	10	402	12	5	220	202	105	5,407	242	120	6,029
Total	230	78	5,042	313	139	4,714	388	195	11,272	931	412	21,028
1974:												
Albania	--	--	--	7	3	218	--	--	--	7	3	218
Philippines	253	81	5,517	6	2	135	5	2	130	264	85	5,782
Rhodesia, Southern	5	2	106	--	--	--	67	32	2,426	72	34	2,532
South Africa, Republic of	4	1	86	250	111	4,209	87	41	1,960	341	153	6,255
Turkey	11	5	230	23	10	705	86	41	3,372	120	56	4,307
U.S.S.R	48	17	1,263	--	--	--	250	133	8,175	298	150	9,438
Total	321	106	7,202	286	126	5,267	495	249	16,063	1,102	481	28,532

[1] Less than ½ unit.

Table 9.—U.S. imports for consumption of ferrochromium, by country

Year and country	Low-carbon ferrochromium (less than 3% carbon)			High-carbon ferrochromium (3% or more carbon)		
	Gross weight (short tons)	Chromium content (short tons)	Value (thousands)	Gross weight (short tons)	Chromium content (short tons)	Value (thousands)
1973:						
Brazil	--	--	--	7,129	4,160	$1,012
Canada	9	6	$5	--	--	--
Finland	--	--	--	^{r} 13,198	^{r} 6,910	^{r} 1,494
Germany, West	^{r} 2,115	^{r} 1,534	^{r} 1,142	413	263	84
Japan	^{r} 13,044	^{r} 9,053	^{r} 5,093	441	298	119
Norway	3,194	2,163	1,260	1,160	792	281
Rhodesia, Southern	^{r} 6,321	^{r} 4,505	2,508	^{r} 47,190	32,166	^{r} 8,040
South Africa, Republic of	^{r} 14,817	^{r} 9,796	^{r} 4,936	41,360	23,451	6,448
Spain	--	--	--	1,385	944	302
Sweden	^{r} 6,080	^{r} 4,553	^{r} 2,798	1,160	783	276
Turkey	1,654	1,180	598	--	--	--
Yugoslavia	--	--	--	3,307	2,149	802
Total	^{r} 47,184	^{r} 32,790	^{r} 18,340	^{r} 116,743	^{r} 71,916	^{r} 18,858
1974:						
Australia	--	--	--	14	8	10
Brazil	220	121	21	10,362	5,974	2,641
Canada	--	--	--	5	4	5
Finland	--	--	--	2,309	1,169	448
France	--	--	--	198	102	42
Germany, West	4,736	3,444	2,875	1,702	1,102	576
Japan	6,735	4,602	4,162	1,605	997	1,067
Norway	3,050	2,038	1,710	1,651	1,145	674
Rhodesia, Southern	4,959	3,514	2,258	29,204	19,958	6,520
South Africa, Republic of	19,419	12,429	7,532	44,328	24,512	8,999
Sweden	3,503	2,653	2,437	3,993	2,471	1,275
Taiwan	147	110	88	--	--	--
Turkey	2,205	1,565	745	--	--	--
Yugoslavia	441	287	304	20,787	13,877	10,877
Total	45,415	30,763	22,127	116,158	71,319	33,134

^{r} Revised.

Table 10.—U.S. import duties

Tariff classification	Articles	Rate of duty, Jan. 1, 1975 [1]
	CHROMIUM ORES AND METAL PRODUCTS	
601.15	Chromium ore	Free.
607.30	Ferrochromium, less than 3% carbon	4% ad valorem.
607.31	Ferrochromium, over 3% carbon	0.625 cent per pound on chromium content.
632.18	Unwrought chromium other than alloys: Waste and scrap [2]	5% ad valorem.
	CHROMIUM CHEMICALS AND RELATED PRODUCTS	
420.08	Potassium chromate and dichromate	1.1 cent per pound.
420.98	Sodium chromate and dichromate	0.87 cent per pound.
422.92	Chromium carbide	6% ad valorem.
	CHROMIUM PIGMENTS	
473.10	Chrome green	5% ad valorem.
473.12	Chrome yellow	Do.
473.14	Chromium oxide green	Do.
473.16	Hydrated chromium oxide green	Do.
473.18	Molybdenum orange	Do.
473.19	Strontium chromate	Do.
473.20	Zinc yellow	Do.

[1] Not applicable to countries with centrally controlled economies.

[2] Duty temporarily suspended on waste and scrap.

WORLD REVIEW

The first International Ferroalloy Congress (INFACON–74) was held in Johannesburg, Republic of South Africa, in April 1974. The purpose of INFACON was to stimulate technical interchange on all aspects of ferroalloy production. Much of the subject matter concerned chromium. The Congress was well attended; 342 delegates from 26 countries registered. A published proceedings of the conference was planned by INFACON–74, Private Bag 7 Auckland Park, Johannesburg, Republic of South Africa.

Brazil.—Cia de Ferro-Ligas da Bahia, S.A. (FERBASA) produced nearly 124,000 tons of beneficiated chromite in 1974 compared with 109,000 tons in 1973 and produced 35,000 tons of high-carbon ferrochromium and 2,200 tons of low-carbon ferrochromium. Chromite reserves in Brazil are primarily in Bahia where 30 million tons of 40% Cr_2O_3 chromite are estimated. FERBASA operates two mines near Campo Formoso where beneficiated production of 238,000 tons was forecast for 1975. Plans were moving ahead for production of 1.5 million tons of chromite over a 10-year period by Cia. de Mineração Serra da Jacobina (SERJANA). This new concern is owned 51% by FERBASA and 49% by Brazilian Chrome Resources Development Co., a consortium of Japanese firms.

Table 11.—Chromite: World production, by country
(Thousand short tons)

Country[1]	1972	1973	1974[p]
Albania	[r] [e] 615	674	[e] 730
Brazil	78	109	124
Colombia	(2)	13	[e] 13
Cuba[e]	22	22	22
Cyprus	26	33	[3] 27
Finland	107	149	170
Greece	24	20	11
India	325	317	400
Iran	198	154	[e] 160
Japan	27	26	29
Malagasy Republic	123	174	172
Pakistan	[r] 29	19	[e] 21
Philippines	385	640	584
Rhodesia, Southern[e]	600	600	650
South Africa, Republic of	1,635	1,818	2,069
Sudan	25	35	22
Turkey	435	[e] 500	[e] 550
U.S.S.R.[e]	2,040	2,100	2,150
Yugoslavia	31	11	27
Total	[r] 6,725	7,414	7,931

[e] Estimate. [p] Preliminary. [r] Revised.

[1] In addition to the countries listed, Bulgaria, North Korea and North Vietnam may also produce chromite, but production is not reported and available information is inadequate for formulation of output estimates.

[2] Less than ½ unit.

[3] Exports.

India.—India's chromite production in 1973 declined to 317,000 tons from 325,000 tons in 1972. The drop in production was attributed to monsoon rains in Orissa, delays caused by removal of excessive overburden, lack of ore haulage units, and lack of explosives. Of the 1973 production, Orissa accounted for 97% of the output. India's chromite exports increased from 69,000 tons in 1972 to 273,000 tons, all to Japan. Ferrochromium production in 1973 totaled 5,126 tons, well below the rated capacity of 30,000 tons. Exports totaled 1,347 tons mainly to Japan.

Japan.—Orissa Mining Corp. Ltd., India's largest chromite ore exporter, contracted to supply Marubeni Corp., purchasing agents for the Japanese firms of Nippon Kokan KK and Showa Denko KK, with 200,000 tons of chromite from January 1974 to June 1975. The price was believed to be $41 per ton f.o.b.

Nippon Kokan completed construction of a 56,000-ton-per-year high-carbon ferrochromium plant at Toyama. The furnace was rated at 35 megawatts.

Malagasy Republic.—Compagnie Minière d'Andriaména (COMINA), owned largely by Pechiney-Ugine Kuhlmann (France) with a 20% participation by the Malagasy Government, operated Madagascar's only chromite mine. COMINA operates on a 567-square-mile concession area that contains 30 separate deposits containing about 5 million tons of exploitable ore. COMINA has shown interest in construction of a ferrochromium plant providing the government builds a hydroelectric powerplant.

About 360 chromite outcrops were discovered in the mining district north of Andriamena. The Bureau de Recherches Géologiques et Minières (BRGM) of France, Compagnie Financiere Eurafricaine (subsidiary of Anglo American Corp. of South Africa Ltd.) and Japanese interests were jointly conducting a geological survey and drilling campaign on an area of about 2,200 square miles. The largest outcrop found measured about 700 feet long by 30 feet wide. It was estimated that ore beneath this outcrop could range to 1 million tons.

Pakistan.—Chromite is mined in the Muslimbagh area of Baluchistan Province from ore reserves that have been estimated at 2 to 3 million tons containing 48% Cr_2O_3. Over the past decade, production has averaged about 25,000 tons annually.

Philippines.—Output of chromite decreased 9% compared with that of 1973; 19% was classified as metallurgical ore and 81% as refractory ore. Acoje Mining Co. Inc., the sole metallurgical chromite producer, in 1973 mined and milled 289,000 tons of chromite to produce

108,000 tons of concentrate. The company shipped 118,000 tons of concentrate. Sufficient chromite ore was developed in 1973, beyond the previous limits of positive ore, to replace ore mined. At yearend, reserves totaled nearly 1.8 million tons of chromite. Consolidated Mines Inc. reported ore reserves of 8.8 million tons of refractory chromite in 1973.

Rhodesia, Southern.—Rio Tinto (Rhodesia) Ltd. reportedly was building a large-scale ferrochromium plant at Eiffel Flats, which was scheduled for completion at yearend. The new plant is located at the old Cam and Motor mine where housing, electricity, and rail facilities exist. Water supply will come from the new Claw Dam.

Rhodesian Vanadium Corp. (RVC) became part of Anglo American Corp. in November. RVC operates three chromite mines.

South Africa, Republic of.—Johannesburg Consolidated Investment Co. Ltd. (JCI) announced plans to form a South African company to produce and market high-carbon ferrochromium using a prereduced pellet (SRC) process. JCI entered into an agreement with Showa Denko KK of Japan to establish a 132,000-ton-per-year ferrochromium facility. The Japanese firm agreed to purchase a minimum of 34,000 tons annually.

That underground mines can be operated safely was pointed out when Chrome Corp. S.A. (Pty.) Ltd., a subsidiary of Union Carbide Corp., achieved a safety record of working 1.25 million man-shifts without a fatality including 1 million man-shifts for underground workers. The latter accomplishment occurred during the period of October 1951 to July 1974.

General Mining & Finance Corp. and Union Carbide Corp. announced a joint venture to build a 135,000-per-year ferrochromium facility in the Eastern Transvaal. General Mining will hold 51% equity in the new company and Union Carbide, 49%. General Mining will supply the new plant with chromium ore under a long-term contract. Union Carbide will provide the technology and engineering expertise for the facility. The new plant is scheduled for completion in the second half of 1976. Both General Mining and Union Carbide will act as marketing agents for the plant output.

Feralloys Ltd. (FL), subsidiary of Associated Manganese Mines of South Africa, announced plans to expand production facilities at its Cato Ridge and Machadodorp plants. FL produces manganese alloys at Cato Ridge and chromium alloys at Machododorp. The new facilities were scheduled for completion in 1977.

Vereeniging Refractories Ltd. constructed a new plant to increase production of basic brick (magnesite and chromium-magnesite). The new plant at the Main Works of Vereeniging will supplement current production owing to expansion of South Africa's steel industry. Wherever possible, mechanized equipment was installed to improve productivity.

Amcor Ltd. concluded long-term contracts for ferrochromium with two Japanese firms. Amcor announced that a third 48-megavolt-ampere (mVA) furnace was under construction at its Witbank plant, which will have a capacity of 55,000 tons per year.

Turkey.—According to the Turkish Chrome Producers Association, Turkey exported nearly 530,000 tons of chromite in 1974. The United States received 31% of the total, followed by France, 12%; Norway, 12%; and Switzerland, 10%. The public sector accounted for 56% of shipments; the private sector accounted for the balance. Over 69% of the shipments was from the port of Iskenderum. Ferrochromium exports totaled nearly 8,859 tons.

TECHNOLOGY

Japanese investigators first described production of high-carbon ferrochromium by prereduction of chromite in 1971. Developed by Showa Denko KK, the process was named the SRC system. Further technical points from pulverizing through smelting were described.[4]

A plant to produce ferrochromium-silicon was described.[5] Operating and production data together with metallurgical balances were also presented. A comparison was made between actual results and basic thermodynamic calculations with regard to a number of operating variables.

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[4] Otani, Y., and K. Ichikowa. Manufacture and Use of Pre-Reduced Chromium Ore Pellets INFACON–74 (Proceedings of the First International Ferro-Alloys Congress, Johannesburg, 22 to 26 April, 1974), 1975, pp. 31–37.

Ichikowa, K. High-Carbon Ferrochrome Route Slashes Power Use. Chem. Eng., v. 81, No. 7, Apr. 1, 1974, pp. 36–37.

[5] Clark, P. W. The Production of Ferrosilicon-Chromium by the Single-Stage Process. INFACON–74 (Proceedings of the First International Ferro-Alloys Congress, Johannesburg, 22 to 26 April, 1974), 1975, pp. 275-280.

To better understand the mechanism of various reactions occurring during the smelting of high-carbon ferrochromium, a new technique was employed to measure the reduction of both iron and chromium to metal during smelting. At temperatures up to 1,500° C, reduction of chromite is controlled by diffusion of iron and chromium in the chromite spinel. At 1,500° C, the reduction rate of the chromium is increased by the fluxing action. In the presence of slag above 1,500° C, the reduction of chromite by carbon is rapid. These mechanisms are not independent of one another but have to occur in the order described.[6]

A process was described that produced low-carbon ferrochromium from South African Transvaal low-ratio chromite. Chromite fines and dolomite were melted in a slag furnace and reduced to 50%-55% chromium ferrochromium containing a maximum of 0.05% carbon using 75% ferrosilicon as a reductant. Costs for a hypothetical 20,000-ton-per-year plant located in the Transvaal were also given.[7]

Results of laboratory work and plant operations of a chromite pelletizing plant using the Lepol process were described.[8]

A careful dissection of an electric furnace revealed insights into furnace interior under melting conditions, the mechanism of melting and reduction processes, the mechanism of decarburization at the ore layer, composition of the slag layer, composition of the metal layer, and behavior of sulfur. Operations were suspended at an experimental electric furnace used to make high-carbon ferrochromium, the furnace was quenched with nitrogen, and resin was embedded in the material within the furnace interior.[9]

The role of chromium in human and animal nutrition was reviewed.[10] Essentially a review of the literature on the role of chromium in nutrition, this publication brings together studies on the subject and poses new problems to be solved.

Patent activity during the year concerned agglomeration of chromite to form a material for use in an electric furnace producing ferrochromium;[11] direct briquetting and reduction of oxide ores;[12] and methods of recovery of chromium values from chromite by solution methods.[13]

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[6] Urquhart, R. C., P. R. Jochens, and D. D. Howat. A Laboratory Investigation of the Smelting Mechanisms Associated With the Production of High-carbon Ferrochromium INFACON-74 (Proceedings of the First International Ferro-Alloys Congress, Johannesburg, 22 to 26 April, 1974), 1975, pp. 195–205.

[7] Bleloch, W. The Reduction of Chromite Fines With Ferrosilicon. INFACON-74 (Proceedings of the First International Ferro-Alloys Congress, Johannesburg, 22 to 26 April, 1974), 1975, pp. 61–67.

[8] Lankes, E. and W. Boehm. Experience and Operational Results Obtained With a Chromium Ore Pelletizing Plant Based on the Lepol Process. INFACON-74 (Proceedings of the First International Ferro-Alloys Congress, Johannesburg, 22 to 26 April, 1974), 1975, pp. 39–46.

[9] Yamagishi, K., K. Endo, and J. Saga. A Comprehensive Analysis of Furnace Interior for High-Carbon Ferrochromium. INFACON-74 (Proceedings of the First International Ferro-Alloys Congress, Johannesburg, 22 to 26 April, 1974), 1975, pp. 143–148.

[10] Goncharov, A. T. Role of Chromium in Human and Animal Nutrition. Vopr. Pitaniya, v. 27, No. 6, 1968, pp. 59–66, available National Technical Information Service, Springfield, Va. 22151, TT72–51078.

[11] Kusama, F., S. Nakajima, M. Yamanaka, and Y. Sazuki (assigned to Showa Denko K. K.). Sintered Agglomerates and Method of Producing Same. U.S. Pat. 3,802,864, Ap. 11, 1974.

[12] Baum, J. J. Direct Reduction Method Using Inductive Heating. U.S. Pat. 3,844,765, Oct. 29, 1974.

[13] Bruen, C. P., and C. A. Wamser (assigned to Allied Chemical Corp.). Process for Recovering Chromium Values From Chrome Ore. U.S. Pat. 3 787,555, Jan. 22, 1974.

Bruen, C. P., C. A. Wamser, and T. R. Moran (assigned to Allied Chemical Corp.). Method of Extracting and Recovering Chromium Values From Chromite Ore. U.S. Pat., 3,790,456, Feb. 5, 1974.

Schafer, H., and H. G. Nieder-Vahrenkolz (assigned to Bayer A.G.). Process for the Production of Alkali-Chromate. U.S. Pat. 3,812,234, May 21, 1974.

Low, W. W., D. G. Frick, and A. B. Ganey (assigned to Allied Chemical Corp.). U.S. Pat. 3,816,094, June 11, 1974.

Shaffer, F. K., and I. G. Arnold, Jr. (assigned to Diamond Shamrock Corp.), Alkali-Metal Chromate Production. U.S. Pat. 3,819,800, June 25, 1974.

Bruen, C. P., W. W. Low, and E. W. Smalley (assigned to Allied Chemical Corp.). Method for Recovering Chromium Values From Chromite Ore. U.S. Pat. 3,816,095, June 11, 1974.

Bruen, C. P., W. W. Low, and E. W. Smalley (assigned to Allied Chemical Corp.). Process for the Production of Sodium Chromate From Chromite. U.S. Pat. 3,852,059, Dec. 3, 1974.

Clays

By Sarkis G. Ampian[1]

Clays in one or more of the classification categories (kaolin, ball clay, fire clay, bentonite, fuller's earth or common clay and shale) were produced in 47 States and Puerto Rico. Clay production was not reported in Alaska, the District of Columbia, Rhode Island, or Vermont. The States leading in output were Georgia, 7.7 million tons; Texas, 5.3 million tons; and Ohio, 4.3 million tons; followed in order by North Carolina, Alabama, and Pennsylvania. Georgia also led in total value of clay output with $204.0 million; Wyoming was second with $29.3 million. Compared with 1973 figures, clay production increased in 17 States and value increased in 33 States. Total quantity of clays sold or used by domestic producers in 1974 was 6% lower in tonnage and 19% higher in total value. The total value of clays produced was an alltime high. Modest increases in value per ton were reported for all clays in 1974 owing to increased labor, fuel, and material costs. The energy crisis or, more specifically, the increasing shortage and cost of fuels continued to cause much concern among clay producers and clay product manufacturers. Industrywide efforts were made to both economize and obtain standby fuels for their requirements. The costs of environmental protection equipment and environment restrictions, and rising capital costs, combined with the energy crisis, continued to adversely affect production during 1974.

Production of the speciality clays, kaolin, ball clay, fire clay, bentonite, and fuller's earth, all increased while common clay and shale declined. A downturn in construction rates that lowered the demand for materials manufactured from common clay and shale (brick, lightweight aggregate, vitrified clay pipe, clay floor and wall tile, etc.) was responsible for the decline. Production of kaolin increased 7%; ball clay, 7%; fire clay, 2%; bentonite, 8%; and fuller's earth, 8%. Common clay and shale decreased 9%.

Kaolin in 1974 accounted for only 10% of the total clay production but 49% of the domestic clay and shale value.

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[1] Physical scientist, Division of Nonmetallic Minerals.

Table 1.—Salient clay and clay products statistics in the United States[1]
(Thousand short tons and thousand dollars)

	1970	1971	1972	1973	1974
Domestic clays sold or used by producers	54,853	56,666	59,456	64,351	60,796
Value	$267,912	$274,431	$303,022	$354,058	$422,542
Exports	2,076	1,973	1,847	2,097	2,451
Value	$66,116	$65,329	$66,216	$79,774	$114,212
Imports for consumption	87	64	67	53	43
Value	$1,802	$1,501	$1,309	$1,879	$2,198
Clay refractories, shipments (value)	$256,384	$236,563	$274,679	r $327,265	$410,153
Clay construction products, shipments (value)	$554,431	$641,567	$722,236	r $772,723	$694,737

r Revised.
[1] Excludes Puerto Rico.

DOMESTIC PRODUCTION, PRICES, AND FOREIGN TRADE, BY TYPE OF CLAY

KAOLIN

Domestic production of kaolin in 1974 increased 7%, and the value increased 28%. The average unit value for all grades of kaolin in 1974 was $32.67 per ton, $5.41 higher than in 1973. Kaolin was produced at mines in 14 States. Two States, Georgia (75%) and South Carolina (12%), accounted for 87% of the total U.S. production in 1974, Alabama ranked third, Texas fourth, and Missouri fifth. Output in 1974 increased in Alabama, California, Georgia, Minnesota, Missouri, Nevada, and South Carolina and declined in Arkansas, Florida, North Carolina, Pennsylvania, Texas, and Utah. Colorado became a new producing State in 1974. No kaolin production was reported in 1974 in Arizona, Idaho and Indiana.

Kaolin is defined as a white, claylike material approximating the mineral kaolinite. It has a specific gravity of 2.6 and a fusion point of 1,785° C. The other kaolin-group minerals, such as halloysite and dickite, are encompassed.

During 1974 J. M. Huber Corp. completed construction of one of the world's largest spray dryers at its Wren, Ga., facility and developed a new mining area in the Edisto River region of Aiken County, S.C. Thiele Kaolin Co. brought a new mine and washer in Washington County, Ga., into full production. Thiele Kaolin Co. (Reedy Creek Division) and Albion Kaolin Co. added slurry production to their airfloat plants. Anglo-American Clays, a division of English China Clays, completed expansion of its plant in Sandersville, Ga. Thiele Kaolin Co. also put a large high-gradient magnetic separator (HGMS) on line during the year, making a total of four operating magnetic separators in the kaolin industry. Exploration geologists from several aluminum companies have increased their activities in Georgia and other areas of the country where kaolin is abundant. American Cyanamid Co. replaced bauxite with kaolin in its process for producing alum (hydrous aluminum sulfate).

Exports of kaolin, as reported by the U.S. Department of Commerce, increased from 732,000 tons valued at $30.5 million in 1973 to 849,000 tons valued at $42.1 million in 1974. The tonnage and value of the kaolin exported in 1974 increased 16% and 38%, respectively, over that shipped in 1973. The unit value per ton increased $7.86, which was attributable to both the greater percentage of higher quality paper-coating grades shipped and higher prices.

Kaolin was exported to 57 countries. The major recipients were Japan, 24%; Canada and Italy, 19% each; and West Germany, 17%. Exports to the remaining countries increased, except for those to Australia, Japan, and West Germany, which decreased 62%, 10%, and 3%, respectively. Kaolin producers reported the end use for their exports as follows: Paper coating, 55%; paper filling, 17%; refractories, 14%; rubber, 6%; and others, including fiberglass, paint, and plastics, 8%.

Kaolin imports in 1974 returned to the downward trend reported for a number of years by decreasing from 34,203 tons valued at $881,000 in 1973 to 19,111 tons valued at $750,000. The United Kingdom supplied 95%; Canada, nearly 5%; and three other countries, less than 0.5%.

Kaolin prices quoted in the trade journals in 1974 all advanced from 1973. Chemical Marketing Reporter, December 30, 1974, quoted prices as follows:

Waterwashed, fully calcined, bulk, carload lots, f.o.b. Georgia, per ton	$110.00
Partially calcined, same basis, per ton	110.00
Paper-grade, uncalcined, same basis, per ton:	
No. 1 coating	53.00
No. 2 coating	43.00
No. 3 coating	$42.00–43.00
Filler, general purpose, same basis, per ton	27.00–28.00
Delaminated, waterwashed, uncalcined, paint-grade, 1-micrometer average, same basis, per ton	91.00
Dry-ground, air-floated, soft, same basis, per ton	10.00
National Formulary, powder, 50-pound bags, 5,0000-pound lots, works, per pound	.07
National Formulary, colloidal, 150-pound drums, works, per pound	.36

The average unit value reported by domestic kaolin producers was $32.67 per ton, an increase of $5.41 above the 1973 value.

Table 2.—Clays sold or used by producers in the United States in 1974, by State[1]

(Short tons)

State	Kaolin	Ball clay	Fire clay	Ben-tonite	Fuller's earth	Common clay and shale	Total	Total value
Alabama	337,471	--	316,401	W	--	2,341,508	[2]2,995,380	[2]$13,298,240
Arizona	--	W	W	32,803	--	163,816	198,672	621,737
Arkansas	80,386	--	--	--	--	903,711	984,097	1,597,397
California	42,707	W	157,125	56,427	W	2,239,161	2,497,241	7,626,341
Colorado	7,950	--	53,263	4,124	--	597,943	663,280	1,588,214
Connecticut	--	--	--	--	--	155,579	155,579	363,446
Delaware	--	--	--	--	--	14,049	14,049	8,429
Florida	27,270	--	--	--	412,523	368,556	808,349	[3]14,261,468
Georgia	4,762,000	--	W	--	489,204	2,440,755	[4]7,691,959	[4]203,936,262
Hawaii	--	--	--	--	--	W	W	W
Idaho	--	--	W	--	--	9,295	[4]9,295	[4]10,348
Illinois	--	--	102,585	--	W	1,484,461	[5]1,587,046	[5]3,744,447
Indiana	--	--	26,236	--	--	1,065,897	1,092,133	1,946,636
Iowa	--	--	--	--	--	960,221	960,221	1,869,045
Kansas	--	--	--	--	--	1,310,576	1,310,576	1,785,130
Kentucky	--	W	116,787	--	--	731,423	[6]848,210	[6]1,476,562
Louisiana	--	--	--	--	--	770,254	770,254	1,425,260
Maine	--	--	--	--	--	146,333	146,333	182,716
Maryland	--	W	--	--	--	844,189	[6]884,189	[6]2,065,548
Massachusetts	--	--	--	--	--	217,685	217,685	378,780
Michigan	--	--	--	--	--	2,160,928	2,160,928	4,078,629
Minnesota	W	--	--	--	--	W	W	W
Mississippi	--	W	--	333,533	W	1,492,249	2,012,888	10,468,010
Missouri	99,000	--	924,197	W	W	1,541,656	[2,5]2,564,853	[2,3,5]13,151,317
Montana	--	--	W	239,290	--	58,624	[4]297,914	[4]2,189,378
Nebraska	--	--	--	--	--	182,394	182,394	413,878
Nevada	2,406	--	104	W	80	W	38,970	218,126
New Hampshire	--	--	--	--	--	33,827	33,827	55,825
New Jersey	--	--	36,849	--	--	66,827	103,676	524,210
New Mexico	--	--	W	--	--	55,336	[4]55,336	[4]316,628
New York	--	W	--	--	--	1,450,564	[6]1,450,564	[6]2,348,006
North Carolina	W	--	--	--	--	3,421,825	[3]3,421,825	[3]4,648,855
North Dakota	--	--	--	--	--	W	W	W
Ohio	--	--	1,123,506	--	--	3,201,686	4,325,142	13,488,248
Oklahoma	--	--	--	--	--	1,288,938	1,288,938	2,105,382
Oregon	--	--	--	1,119	--	138,649	139,768	242,609
Pennsylvania	W	--	894,458	--	--	1,837,522	[3]2,731,980	[3]16,495,699
Puerto Rico	--	--	--	--	--	291,007	291,007	332,481
South Carolina	769,709	--	--	--	W	1,527,252	[5]2,296,961	[5]13,765,142
South Dakota	--	--	--	W	--	189,592	[2]189,592	[2]201,654
Tennessee	--	500,323	--	--	W	1,137,603	[5]1,637,926	[5]9,776,204
Texas	W	40,731	40,754	68,575	W	5,045,922	5,314,770	13,677,250
Utah	W	--	W	3,153	2,174	201,201	231,880	952,946
Virginia	--	--	--	--	--	1,956,746	1,956,746	2,613,820
Washington	--	--	W	--	--	269,425	[4]269,425	[4]698,235
West Virginia	--	--	W	--	--	338,817	[4]338,817	[4]520,315
Wisconsin	--	--	--	--	--	2,385	2,385	4,393
Wyoming	--	--	--	2,295,248	--	215,903	2,511,151	29,338,785
Undistributed	263,927	276,122	348,576	276,228	320,659	289,104	[7]1,403,116	[7]22,068,294
Total	6,392,826	817,176	4,140,841	3,310,500	1,224,640	45,201,344	61,087,827	422,874,315

W Withheld to avoid disclosing individual company confidential data; included with "Undistributed."

[1] Includes Puerto Rico.
[2] Excludes bentonite.
[3] Excludes kaolin.
[4] Excludes fire clay.
[5] Excludes fuller's earth.
[6] Excludes ball clay.
[7] Incomplete total; remainder included in State totals.

Table 3.—Kaolin sold or used by producers in the United States, by kind and use

(Short tons)

Use	1973 Airfloat	1973 Un-processed	1973 Water-washed [1]	1973 Total	1974 Airfloat	1974 Un-processed	1974 Water-washed [1]	1974 Total
Domestic:								
Adhesives	52,587	--	12,066	64,653	54,521	--	11,538	66,059
Alum (aluminum sulfate) and other chemicals	--	198,917	28,863	227,780	37,841	288,957	1,452	328,250
Animal feed	10,159	--	4,840	14,999	11,480	--	3,398	14,878
Brick, face	565	381,754	300	382,619	355	424,475	498	425,328
Catalysts (oil refining)	W	W	W	89,337	12,025	21,623	36,288	69,936
Caulking, putty, and sealing	--	--	(2)	(2)	W	--	W	5,016
Cement, portland	--	86,507	20,730	107,237	1,169	110,380	22,726	134,275
Ceramic (hobby)	--	--	--	--	W	W	--	647
China/dinnerware	21,278	--	8,464	29,742	12,553	--	9,002	21,555
Crockery and other earthenware	3,623	--	--	3,623	68,460	--	4	68,464
Electrical porcelain	11,410	--	4,500	15,910	10,108	--	5,325	15,433
Fertilizers [3]	41,376	--	30,902	72,278	W	--	W	88,087
Fiberglass	W	--	W	189,311	112,905	--	15,079	127,984
Firebrick, block, shapes	41,977	270,205	--	312,182	65,132	382,963	1,153	449,248
Floor and wall tile, ceramic	29,162	--	4,833	33,995	12,395	--	4,687	17,082
Flue linings and high alumina brick	(2)	(2)	--	(2)	W	--	--	78,719
Foundry sand	--	--	(2)	(2)	154	5,137	81	5,372
Glazes, glass, enamels	687	--	7,450	8,137	507	--	4,733	5,240
Grogs and crudes, refractory	W	W	--	153,179	W	W	--	277,362
Gypsum products	52,394	--	3,861	56,255	1,145	--	3,677	4,822
Ink	--	--	(2)	(2)	W	--	W	14,162
Kiln furniture	(2)	--	--	(2)	2,245	--	--	2,245
Medical, pharmaceutical, cosmetic	--	--	(2)	(2)	1,377	--	609	1,986
Mortar and cement, refractory	--	(2)	(2)	(2)	--	W	W	1,855
Paint	17,703	--	114,270	131,973	60,625	--	200,737	261,362
Paper coating	71,502	--	1,539,409	1,610,911	5,226	--	1,308,180	1,313,406
Paper filling	194,151	--	630,474	824,625	201,283	--	810,846	1,012,129
Pesticides and related products	W	--	W	28,750	24,787	--	3,724	28,511
Plastics	7,539	--	55,089	62,628	7,550	--	46,725	54,275
Pottery	12,474	--	2,676	15,150	23,659	--	18,400	42,059
Roofing granules	W	--	W	306	--	--	--	--
Rubber	343,759	--	22,939	366,698	357,441	--	21,161	378,602
Sanitary ware	137,778	1,702	41,636	181,116	40,927	22,343	19,504	82,774
Waterproofing and sealing	--	--	--	--	3,554	--	--	3,554
Miscellaneous	68,238	18,107	49,756	136,101	3,679	3,180	19,960	26,819
Undistributed	188,431	189,544	82,908	(4)	159,930	227,105	73,813	(4)
Total	1,306,793	1,146,736	2,665,966	5,119,495	1,293,033	1,486,163	2,643,295	5,417,496

Exports:								
Ceramics	5,292	--	9,059	14,351	2,020	--	3,880	5,900
Chemical manufacturing	--	--	189	189	--	--	105	105
Paint	--	--	19,616	19,616	30	--	17,810	17,840
Paper coating	8,464	--	471,495	479,959	--	--	532,593	532,593
Paper filling	--	--	35,085	35,085	40,537	--	124,203	164,740
Plastics	--	--	(5)	(5)	--	--	25,864	25,864
Grogs and crudes and other refractories	5,000	84,087	120	89,207	17,000	122,187	--	139,187
Rubber	68,739	--	3,681	72,420	55,235	--	1,318	56,553
Other	2,911	--	160,296	163,207	2,676	--	29,872	32,548
Total	90,406	84,087	699,491	873,984	117,498	122,187	735,645	975,330
Grand total	1,397,199	1,230,823	3,365,457	5,993,479	1,410,531	1,603,355	3,378,940	6,392,826

W Withheld to avoid disclosing individual company confidential data; included with "Undistributed."

[1] Includes calcined and delaminated.

[2] Included with "Miscellaneous."

[3] Includes soil conditioners and mulches.

[4] "Undistributed" total included with total for each specific use.

[5] Included with "Other."

Table 4.—Kaolin sold or used by producers in the United States, by State

State	1973		1974	
	Short tons	Value	Short tons	Value
Alabama	127,044	$1,865,601	337,471	$5,954,902
Arizona	5	150	--	--
Arkansas	W	W	80,386	576,911
California	26,251	256,641	42,707	399,581
Colorado	--	--	7,950	23,850
Florida	27,955	789,375	27,270	W
Georgia	4,510,263	144,726,059	4,762,000	183,610,940
Missouri	82,745	W	99,000	W
Nevada	1,950	50,700	2,406	W
South Carolina	754,969	10,353,682	769,709	11,127,572
Other States [1]	462,297	5,829,174	263,927	7,171,103
Total	5,993,479	163,871,382	6,392,826	208,864,859

W Withheld to avoid disclosing individual company confidential data; included with "Other States."

[1] Includes Idaho (1973), Indiana (1973), Minnesota, North Carolina, Pennsylvania, Texas, Utah, and data indicated by symbol W.

Table 5.—Kaolin sold or used by producers in the United States, by kind

Kind	1973		1974	
	Short tons	Value	Short tons	Value
Airfloat	1,397,199	$21,963,180	1,410,531	$26,283,605
Calcined	176,425	12,980,059	206,483	19,402,465
Delaminated	194,180	10,193,638	221,407	13,328,375
Unprocessed	1,230,823	16,623,207	1,603,355	29,231,183
Waterwashed	2,994,852	101,611,298	2,951,050	120,619,231
Total	5,993,479	163,871,382	6,392,826	208,864,859

Table 6.—Georgia kaolin sold or used by producers, by kind

Kind	1973		1974	
	Short tons	Value	Short tons	Value
Airfloat	839,625	$11,629,755	920,463	$15,680,712
Calcined	146,425	11,934,459	159,260	16,956,465
Delaminated	194,180	10,193,638	221,407	13,328,375
Unprocessed	421,905	10,981,783	602,905	18,943,946
Waterwashed	2,908,128	99,986,424	2,857,965	118,701,442
Total	4,510,263	144,726,059	4,762,000	183,610,940

Table 7.—Georgia kaolin sold or used by producers, by kind and use

(Short tons)

Use	1973 Air-float	1973 Unprocessed	1973 Water-washed [1]	1973 Total	1974 Air-float	1974 Unprocessed	1974 Water-washed [1]	1974 Total
Domestic:								
Adhesives	W	--	W	44,218	35,127	--	11,538	46,665
Alum (aluminum sulfate) and other chemicals	--	W	W	131,942	W	W	W	184,730
Animal feed	117	--	--	117	2,644	--	--	2,644
Brick, face	565	--	--	565	--	--	133	133
Catalysts (oil refining)	W	--	W	43,699	W	--	W	46,319
Cement, portland	--	(2)	--	(2)	1,169	64,126	--	65,295
China/dinnerware	W	--	W	18,084	W	--	--	W
Crockery and other earthenware	3,556	--	--	3,556	37,325	--	4	37,329
Electrical porcelain	(2)	--	--	(2)	3,011	--	--	3,011
Fiberglass	W	--	W	134,604	W	--	W	91,513
Firebrick, block, shapes	32,400	47,252	--	79,652	65,100	27,834	1,153	94,087
Floor and wall tile, ceramic	W	--	W	21,485	2,500	--	3,957	6,457
Flue linings and high alumina brick	(2)	(2)	--	(2)	W	W	--	78,719
Foundry sand	--	--	(2)	(2)	154	--	81	235
Grogs and crudes, refractory	W	W	--	153,179	W	W	--	277,862
Gypsum products	W	--	W	52,023	--	--	W	W
Ink	--	--	(2)	(2)	W	--	W	18,883
Medical, pharmaceutical, cosmetic	--	--	(2)	(2)	1,377	--	609	1,986
Paint	11,982	--	99,320	111,302	57,663	--	170,697	228,360
Paper coating	71,502	--	1,539,409	1,610,911	2,000	--	1,308,180	1,310,180
Paper filling	182,570	--	630,474	813,044	197,613	--	795,846	993,459
Plastics	W	--	W	61,889	6,833	--	46,725	53,558
Pottery	W	--	W	9,650	19,894	--	18,400	38,294
Roofing granules	W	--	W	306	--	--	--	--
Rubber	95,208	--	17,619	112,827	115,842	--	15,045	130,887
Sanitary ware	119,920	--	40,945	160,865	W	W	15,441	62,362
Miscellaneous:								
Fertilizers (1974); glazes, glass, enamels; kiln furniture (1974); linoleum (1973); pesticides and related products; waterproofing and sealing (1974); unknown uses; and data indicated by footnote [2]	67,279	--	--	67,279	53,745	--	--	53,745
Data indicated by footnote [2] and other uses (1974)	--	39,481	--	39,481	--	267	--	267
Fertilizers (1973); mineral oil filtering, clarifying, and decolorizing; refractory mortar and cement; textiles; unknown uses; and data indicated by footnote [2]	--	--	46,113	46,113	--	--	18,487	18,487
Undistributed	241,062	251,085	178,932	--	256,978	388,671	99,951	[3]11,153
Total	826,161	337,818	2,552,812	3,716,791	858,975	480,898	2,506,247	3,846,120
Exports:								
Paint	--	--	18,916	18,916	30	--	17,660	17,690
Paper coating	8,464	--	471,495	479,959	--	--	532,593	532,593
Paper filling	--	--	35,085	35,085	40,537	--	124,203	164,740
Plastics	--	--	(2)	(2)	--	--	25,864	25,864
Grogs and crudes and other refractories	5,000	84,087	--	89,087	17,000	122,007	--	139,007
Rubber	--	--	3,681	3,681	3,921	--	1,318	5,239
Miscellaneous	--	--	166,744	166,744	--	--	30,747	30,747
Total	13,464	84,087	695,921	793,472	61,488	122,007	732,385	915,880
Grand total	839,625	421,905	3,248,733	4,510,263	920,463	602,905	3,238,632	4,762,000

W Withheld to avoid disclosing individual company confidential data; included with "Undistributed."

[1] Includes calcined and delaminated.

[2] Included with "Miscellaneous."

[3] Incomplete total; remainder included with total for each specific use.

Table 8.—South Carolina kaolin sold or used by producers, by kind

Kind	1973		1974	
	Short tons	Value	Short tons	Value
Airfloat	499,245	$9,120,829	434,967	$9,364,857
Unprocessed	255,724	1,232,853	334,742	1,762,715
Total	754,969	10,353,682	769,709	11,127,572

Table 9.—South Carolina kaolin sold or used by producers, by kind and use

(Short tons)

Kind and use	1973	1974
Airfloat:		
Adhesives	20,435	19,394
Fertilizers	41,080	22,015
Fiberglass	W	7,006
Firebrick, block, shapes	5,332	W
Paint	W	2,962
Pesticides and related products	21,104	22,397
Rubber	248,496	241,519
Other uses[1]	91,148	65,684
Exports[2]	71,650	53,990
Total	499,245	434,967
Unprocessed:		
Face brick; firebrick, block, and shapes (1974); and sanitary ware	255,724	334,742
Grand total	754,969	769,709

W Withheld to avoid disclosing individual company confidential data; included with "Other uses."

[1] Includes animal feed; crockery and other earthenware (1974); electrical porcelain (1973); fine china-dinnerware (1973); glazes, glass, enamel; gypsum products; ink (1974); linoleum (1974); paper coating (1974); paper filling; plastics; pottery; sanitary ware; other uses (1973); and data indicated by symbol W.

[2] Fertilizers (1973); pesticides and related products (1974); and rubber.

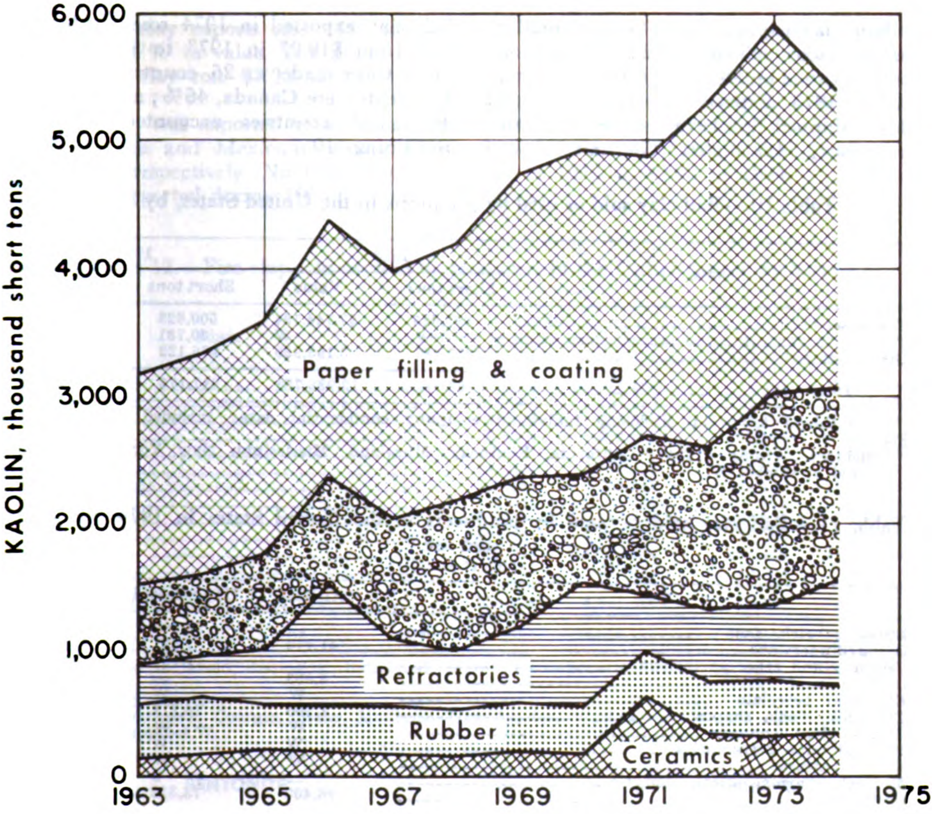

Figure 1.—Kaolin sold or used by domestic producers for specified uses.

BALL CLAY

Production and value reported for domestically mined ball clay in 1974 increased 7% and 9%, respectively. Tennessee mines provided 61% of the Nation's output, followed in order of output by Kentucky, Mississippi, Texas, Maryland, New York,[2] California, and Arizona. Production in Kentucky, Maryland, Mississippi, Tennessee, and Texas increased over that reported in 1973 while California and New York production decreased.

Ball clay is defined as a plastic, white-firing clay used principally for bonding in ceramic ware. The clays are of sedimentary origin and consist mainly of the clay mineral kaolinite and sericite micas.

In 1974 H.C. Spinks Clay Co., Inc. completed its drying and grinding facility at Gleason, Tenn. This facility expands production capacity for air-floated and mechanically dried clays and eliminates costly hauling from its Gleason area mines to other plants.

The average unit value for ball clay reported by domestic producers rose in 1974 to $17.34 per ton, an increase of $0.46 per ton. Chemical Marketing Reporter, December 30, 1974, listed ball clay prices unchanged from 1973 as follows:

Domestic, air-floated, bags, carload lots, Tennessee, per ton	$18.00–$22.00
Domestic, crushed, moisture-repellent, bulk, carload lots, Tennessee, per ton	8.00– 11.25
Imported, air-floated, bags, carload lots, Atlantic ports, per ton	70.00
Imported, lump, bulk, Great Lakes, per ton	40.50

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[2] The famous Albany slip clay is included with ball clay solely for statistical convenience.

Ball clay exports in 1974 amounted to 131,000 tons valued at $2.9 million compared with 114,000 tons worth $2.2 million in 1973. Exports increased 15% over those shipped in 1973, while the value was nearly 34% higher. The unit value of ball clay exported in 1974 rose $3.16 per ton, from $19.27 in 1973 to $22.43. Exports were made to 26 countries: Major recipients were Canada, 46%; and Mexico, 44%; 24 countries accounted for the remaining 10%.

Table 10.—Ball-clay sold or used by producers in the United States, by State

State	1973		1974	
	Short tons	Value	Short tons	Value
Tennessee	487,625	$7,744,794	500,323	$8,403,994
Texas	W	W	40,731	329,290
Other States [1]	279,087	5,193,960	276,122	5,434,063
Total	766,712	12,938,754	817,176	14,167,347

W Withheld to avoid disclosing individual company confidential data; included with "Other States."

[1] Includes Arizona (1974), California, Kentucky, Maryland, Mississippi, New York, and data indicated by symbol W.

Table 11.—Ball clay sold or used by producers in the United States in 1974, by kind and use

(Short tons)

Use	Airfloat	Unprocessed	Total
Building brick, face	--	13,000	13,000
China/dinnerware	41,770	1,521	43,291
Crockery and other earthenware	--	1,137	1,137
Drilling mud	4,663	--	4,663
Electrical porcelain	W	W	45,132
Firebrick, block, shapes	1,200	26,211	27,411
Glazes, glass, enamels	W	W	1,969
High alumina refractories	W	W	22,019
Kiln furniture	W	W	9,349
Medical, pharmaceutical, cosmetic	--	2	2
Pottery	96,400	73,812	170,212
Rubber	400	--	400
Sanitary ware	82,052	92,649	174,701
Floor and wall tile	60,116	28,358	88,474
Quarry tile	--	1,142	1,142
Miscellaneous	92,778	38,709	131,487
Undistributed	21,312	57,157	--
Exports	47,655	35,132	82,787
Total	448,346	368,830	817,176

W Withheld to avoid disclosing individual company confidential data; included with "Undistributed."

FIRE CLAY

Fire clay sold or used by domestic producers in 1974 was reported at 4,140,841 tons valued at $41.1 million. Fire clay is defined as detrital material, either plastic or rocklike, containing low percentages of iron oxide, lime, magnesia, and alkalies to enable the material to withstand temperatures to 1,500° C or higher. Fire clay is basically kaolinite but usually contains other materials such as diaspore, ball clay, bauxite clay, and shale. Fire clays commonly occur as underclay below coal seams and are generally used for refractories. Some fire clay was previously reported in other end uses.

Fire clay production was reported in 1974 from mines in 20 States. The first four States in rank, Ohio, Missouri, Pennsylvania and Alabama, accounted for 79% of the total domestic output.

General Refractories Co., U.S. Refractories Div., announced plans to expand its Gary plant to include a $2 million clay and alumina specialties plant. The new plant was scheduled for completion by the end of 1975.[3]

Exports of fire clay increased from 196,000 tons worth $3.8 million in 1973 to 224,000 tons valued at $6.0 million in

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[3] Journal of Metals. Metallograms-Plan $2 Million Alumina Specialties Plant. V. 26, No. 11, November 1974, p. 10.

1974. Fire clay exports rose 14% in tonnage and 57% in value. The price of exported fire clay rose $7.22 to $26.71 per ton.

Fire clay was exported to 46 countries, with Canada and Mexico receiving 42% and 34%, respectively. No imports of fire clay were reported during 1974.

There are no price quotations in domestic journals for fire clay, but the per ton value reported by producers ranged from $2 to about $10. The reported average unit value for fire clay produced in the United States increased 12%, from $8.89 per ton in 1973 to $9.92 in 1974.

Table 12.—Fire clay sold or used by producers in the United States, by State [1]

State	1973		1974	
	Short tons	Value	Short tons	Value
Alabama	359,840	$3,884,488	316,401	$3,951,624
California	119,364	624,992	157,125	839,369
Colorado	58,126	224,662	53,263	218,638
Illinois	97,270	609,253	102,585	672,992
Indiana	W	W	26,236	118,168
Kentucky	142,556	920,961	116,787	605,966
Missouri	829,484	7,562,661	924,197	10,760,549
Nevada	45	420	104	990
New Jersey	26,403	150,596	36,849	282,110
Ohio	1,095,474	6,326,240	1,123,506	7,223,029
Pennsylvania	891,744	11,070,983	894,458	11,303,889
Texas	87,484	689,200	40,754	316,000
Utah	5,300	32,000	W	W
Other States [2]	354,898	4,061,431	348,576	4,796,552
Total	4,067,988	36,157,887	4,140,841	41,089,876

W Withheld to avoid disclosing individual company confidential data; included with "Other States."

[1] Refractory uses only.

[2] Includes Arizona, Georgia, Idaho, Montana, New Mexico, Washington, West Virginia, and data indicated by symbol W.

BENTONITE

Bentonite production in 1974 increased 8% in tonnage and 26% in value over that of 1973. A general increase in domestic consumption, particularly in iron ore pelletizing, drilling mud, animal feed, and waterproofing and sealing, was noted along with an overall increase in exports.

Bentonite was produced in 13 States. Increased bentonite production was reported for all States except Alabama, Arizona, Missouri, Texas, and Utah.

Generally, the high-swelling or sodium bentonites are produced chiefly in Wyoming, Montana, and South Dakota. The calcium or low-swelling bentonites are produced in the other States.

In 1974, Black Hills Bentonite Co. began production at a major new bentonite operation situated in Washakie County, north central Wyoming. This project consisted of developing a bentonite mining area near Ten Sleep and erecting a processing plant at Worland. The company's annual capacity has been reportedly doubled to 400,000 tons.[4] Industrywide improvements were made in environmental controls systems and in automating, bagging, and handling procedures.

On December 30, 1974, Chemical Marketing Reporter quoted bentonite prices as unchanged from 1973. Domestic, 200 mesh, bags, carload lots, f.o.b. mines, was priced from $15.50 to $16.00 per ton; and imported Italian white, high-gel, bags, 5-ton lots, ex-warehouse, $337.60 ($0.1688 per pound) per ton. The average unit value reported by domestic producers for bentonite sold or used in 1974 was $13.28 an increase of $1.94 from the $11.34 average of the previous year. Per ton values reported in the various producing States ranged from $4 to $36 but, as in 1973, the average value reported by the larger producers was near the Wyoming average figure of $12.58.

Bentonite imports in 1974, including chemically activated material, totaled 3,639 tons valued at $699,000, compared with 2,670 tons valued at $243,000 in 1973.

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[4] Skillings, D.N., Jr. Black Hills Bentonite Co. Opens New Mine and Plant. Skillings' Min. Rev., v. 63, No. 45, Nov. 9, 1974, pp. 1, 6, 10.

The 3,599 tons of chemically activated bentonite was imported from six countries, with Canada supplying 25%; Mexico, 21%; Japan, 52%; and West Germany, Australia, and France the remainder. Special-purpose Italian bentonite was not imported in 1974.

Bentonite exports in 1974 increased from 551,000 tons in 1973 valued at $18.4 million to 714,000 tons valued at $28.1 milllion. Although the tonnage exported increased only 30% above that shipped in 1973, the value increased 56%. The greater increase in value was the result of the unit value of exported bentonite increasing $6.91 per ton, from $33.34 in 1973 to $40.25 in 1974. This increase in per ton value was attributed to a large increase in the amount of higher cost drilling mud and foundry-grade bentonites shipped. Exports in previous years consisted of a larger percentage of the lower cost pelletizing grades. Domestic bentonite producers were facing increased competition in foreign markets. Bentonite from the Greek Island of Milos was being blended with the U.S. clay for pelletizing Canadian taconite ores on a large scale.

Bentonite was exported to 83 countries, an increase of 6 from the previous year. The major recipients were Canada, 38%; West Germany, 10%; the United Kingdom, 9%; Australia, 8% the Netherlands, 5%; Singapore, 4%; Japan, Saudi Arabia, and Venezuela, 3% each; and the 74 others, 17%. Domestic bentonite producers reported the end use of their exports were foundry sand, 44%; iron ore pelletizing, 22%; drilling mud, 29%; and others, including animal feed, ceramics, ore treatment, and waterproofing and sealing, 5%.

Table 13.—Bentonite sold or used by producers in the United States, by State

State	1973		1974	
	Short tons	Value	Short tons	Value
Arizona	35,067	$394,588	32,803	$382,545
California	49,682	823,102	56,427	1,520,221
Colorado	1,012	6,525	4,124	37,688
Mississippi	286,135	3,606,984	333,533	4,599,118
Missouri	74,000	W	W	W
Montana	176,586	1,232,400	239,290	2,091,677
Oregon	875	10,495	1,119	13,423
Texas	84,620	802,182	68,575	881,065
Utah	4,880	64,830	3,153	49,172
Wyoming	2,106,369	23,529,610	2,295,248	28,882,276
Other States[1]	253,316	4,368,040	276,228	5,512,950
Total	3,072,542	34,838,756	3,310,500	43,970,135

W Withheld to avoid disclosing individual company confidential data; included with "Other States."

[1] Includes Alabama, Idaho (1973), Nevada, Oklahoma (1973), South Dakota, and data indicated by symbol W.

Table 14.—Bentonite sold or used by producers in the United States in 1974, by type and use

(Short tons)

Use	Nonswelling	Swelling	Total
Domestic:			
Animal feed	46,532	129,174	175,706
Building brick, face	--	2,922	2,922
Catalysts (oil refining)	4,853	26	4,879
Cement, portland	--	459	459
Drilling mud	15,180	584,508	599,688
Fertilizers	6,490	--	6,490
Filtering, clarifying and decolorizing:			
Animal oils and mineral oils and greases	83,535	8,269	91,804
Vegetable oils	71,290	--	71,290
Foundry sand	270,395	467,660	738,055
Glazes, glass, enamels	--	209	209
Gypsum products	--	506	506
Medical, pharmaceutical, cosmetic	200	14,678	14,878
Oil and grease absorbents	W	W	14,860
Paint	--	4,915	4,915
Pelletizing (iron ore)	--	870,464	870,464
Pesticides and related products	21,525	2,328	23,853
Pet absorbent	W	W	6,319
Pottery	307	--	307
Sewer pipe (vitrified)	100	--	100
Roofing tile	13,129	--	13,129
Waterproofing and sealing	1,407	84,888	86,295
Miscellaneous	27,060	54,348	[1] 60,229
Total	562,003	2,225,354	2,787,357
Exports:			
Drilling mud	--	152,912	152,912
Foundry sand	16,781	215,142	231,923
Pelletizing (iron ore)	--	112,833	112,833
Other	4,458	21,017	25,475
Total	21,239	501,904	523,143
Grand total	583,242	2,727,258	3,310,500

W Withheld to avoid disclosing individual company confidential data; included with "Miscellaneous."

[1] Incomplete total; remainder included in total for each specific use.

Table 15.—U.S. exports of bentonite as reported by producers, by use

(Short tons)

Use	1973	1974
Drilling mud	110,430	152,912
Foundry sand	180,383	231,923
Pelletizing (iron ore)	126,998	112,833
Other [1]	20,405	25,475
Total	438,216	523,143

[1] Includes animal feed, ceramics, face brick, chemical manufacturing, mineral wool and insulation, waterproofing and sealing, and other uses.

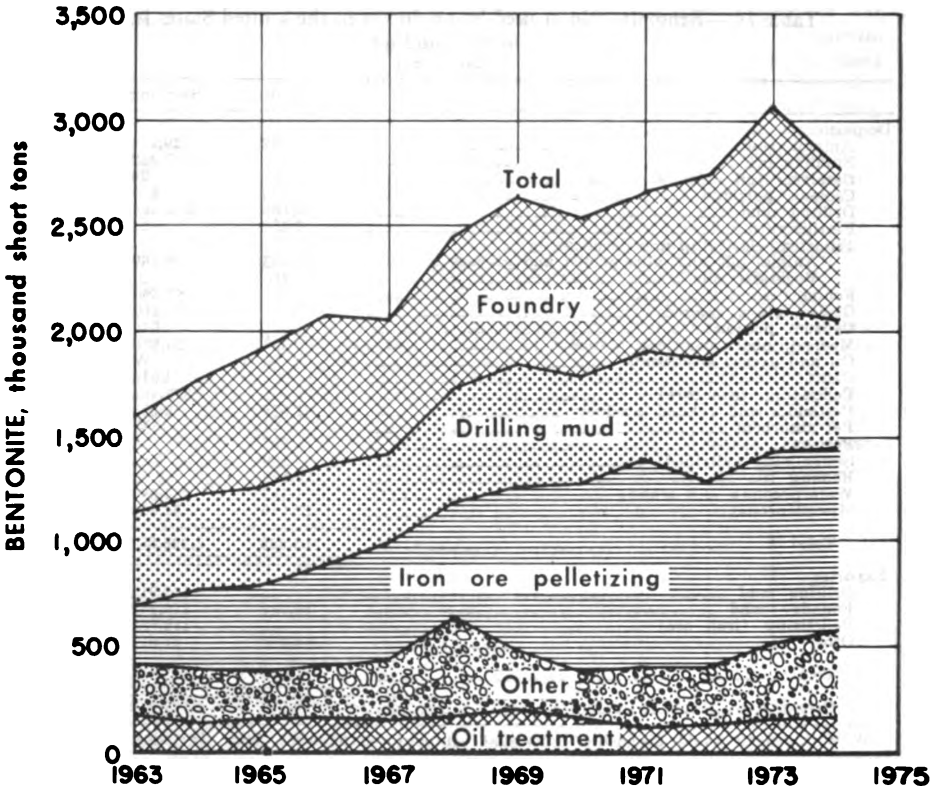

Figure 2.—Bentonite sold or used by domestic producers for specified uses.

FULLER'S EARTH

Production of fuller's earth in 1974 increased 8% in quantity and 32% in total value. The unit value assigned by domestic producers increased $5.38 in 1974 to $29.45 per ton. This increase was due to large increases in unit value by both the Florida and Georgia producers.

Fuller's earth production was reported from operations in 11 States, an increase of 2 States compared with 1973. The two top producing States, Georgia (40%) and Florida (34%), accounted for 74% of the domestic production. The other nine States accounted for the remaining 26%. Georgia, Mississippi, Tennessee, California, South Carolina, Texas, and Illinois showed gains in production while Florida and Utah declined slightly. The new producing States in 1974 were Missouri and Nevada.

Fuller's earth is defined as a nonplastic clay or claylike material, usually high in magnesia, which has adequate decolorizing and purifying properties.

Production from the region that includes Attapulgus (Decatur County), Ga., and Quincy (Gadsden County), Fla., is composed predominantly of the distinct lath-shaped amphibole clay mineral attapulgite. Most of the fuller's earth produced in the other areas of the United States contains varieties of montmorillonite.

Prices for fuller's earth were not publicly quoted in 1974, but the per ton value for attapulgite reported by producers ranged from $20 to over $63; montmorillonite prices ranged from $15 to under $35.

Exports of fuller's earth to 42 countries decreased from 58,000 tons valued at $2.7 million in 1973 to 56,000 tons valued at $3.2 million in 1974. Export tonnage decreased 3%, but its value increased nearly 18%. The unit value of exported fuller's earth rose $10.42 per ton. The major recipients were Canada, 38%; the United Kingdom, 21%; the Netherlands, 9%; Belgium-Luxembourg and France, 7% each; and other countries, the remaining 18%.

Imports of fuller's earth in 1974 were only 1 ton valued at $280 from Mexico.

Table 16.—Fuller's earth sold or used by producers in the United States, by State

State	1973		1974	
	Short tons	Value	Short tons	Value
Florida	419,168	$12,001,931	412,523	$13,717,627
Georgia	444,326	10,499,157	489,204	15,440,560
Nevada	--	--	80	2,386
Utah	2,870	62,000	2,174	46,000
Other States[1]	272,069	4,835,553	320,659	6,854,141
Total	1,138,433	27,398,641	1,224,640	36,060,714

[1] Includes California, Illinois, Mississippi, Missouri (1974), South Carolina, Tennessee, and Texas.

Table 17.—Fuller's earth sold or used by producers in the United States in 1974, by type and use

(Short tons)

Use	Attapulgite	Montmorillonite	Total
Domestic:			
Adhesives	1,525	--	1,525
Cement, portland	W	W	19,690
Drilling mud	75,976	--	75,976
Fertilizers	38,966	15,550	54,516
Filtering, clarifying, and decolorizing mineral oils and greases	30,917	211	31,128
Medical, pharmaceutical, cosmetic	16	--	16
Oil and grease absorbents	268,918	140,816	409,784
Paint	1,662	--	1,662
Paper coating	71	--	71
Pesticides and related products	143,164	36,415	179,579
Pet absorbent	139,859	218,134	357,998
Miscellaneous	9,062	21,117	[1]10,489
Total	710,136	432,243	1,142,379
Exports:			
Catalysts (oil refining)	W	W	8,907
Drilling mud	1,256	--	1,256
Fertilizers	W	W	4,764
Oil and grease absorbents	19,011	5,222	24,233
Pet absorbent	30,310	4,406	34,716
Miscellaneous	19,664	2,392	[1]8,385
Total	70,241	12,020	82,261
Grand total	780,377	444,263	1,224,640

W Withheld to avoid disclosing individual company confidential data; included with "Miscellaneous."

[1] Incomplete total; remainder included in total for each specific use.

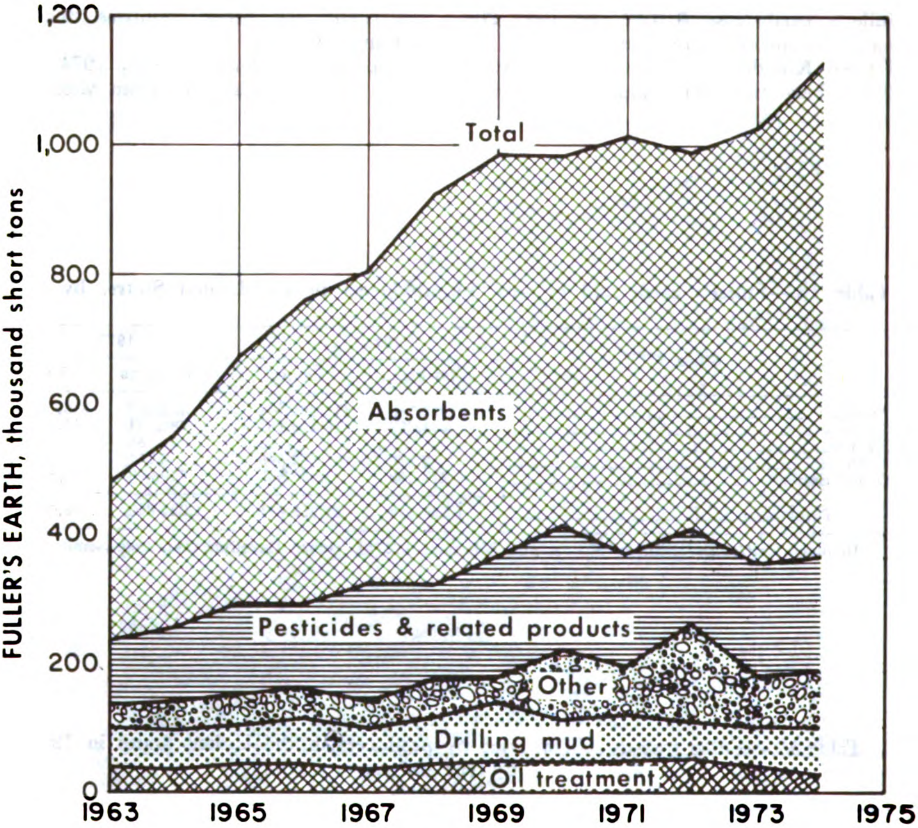

Figure 3.—Fuller's earth sold or used by domestic producers for specified uses.

COMMON CLAY

Domestic production of common clay and shale in 1974 totaled 44.9 million tons valued at $78.4 million. Common clay and shale represented 74% of the quantity and 19% of the value of the total clay and shale produced domestically in 1974. In addition, Puerto Rican production of common clay and shale was reported at 291,007 tons valued at $332,481. Domestic output in 1974 decreased 9% below that reported for 1973.

Common clays and shales are for the most part used by the producer in fabricating or manufacturing a product. Less than 10% of the total clay and shale output was sold. The average unit value for all common clay and shale produced in the United States and Puerto Rico in 1974 was $1.74 per ton, $0.14 more than in 1973. The range in unit value reported for the bulk of the output was from $1 to $2 per ton.

Common clay is defined as a clay or claylike material which is sufficiently plastic to permit ready mold and vitrification below 1,100° C. Shale is a consolidated sedimentary rock composed chiefly of clay minerals that have been both laminated and indurated while buried under other sediments. These materials are used in the manufacture of structural clay products, such as brick and drain tile, portland cement clinker, and bloated lightweight aggregate.

In 1974, a new brick plant capable of producing 60 million brick per year was put onstream at Galloway, Tenn. The plant was funded by a $2.8 million bond issue approved by the Galloway Industrial Board. A new tunnel kiln was put into production in Roanoke, Va., by the Webster Brick Co., Inc. The Cohoes, N.Y., lightweight aggregate plant of United States Steel Corp. was acquired by Norlite Corp., subsidiary of P. K. Keating Co. Keating is a Massachusetts-based aggregate and concrete producer. Norlite will be marketed throughout New England and New York.[5] Savings in fuel consumption and increased production at Georgia Lightweight Aggregates Co., Rockmart, Ga., was accomplished by installing lifters in its rotary kiln.

The output of the energy-intensive common clay and shale industry was curtailed by shortages of fuel, labor, and a downturn in construction in 1974. Industrywide attention was focusing on coal firing as a possible escape from the high cost and shortages of oil and gas.

Exports of common clay and shale are not tallied by the U.S. Department of Commerce. Most countries have local deposits of either clays or shales which are adequate for manufacturing structural clay products, cement clinker, and lightweight aggregates, and thus have no need to import such materials.

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[5] Rock Products. Rock Newscope—Lightweight Aggregate Plant Changes Hands. V. 77, No. 9, September 1974, p. 17.

Table 18.—Common clay and shale sold or used by producers in the United States, by State [1]

State	1973		1974	
	Short tons	Value	Short tons	Value
Alabama	2,446,648	$3,537,518	2,341,508	$3,391,714
Arizona	82,241	64,336	163,816	224,345
Arkansas	1,445,790	1,411,558	903,711	1,020,486
California	2,526,158	5,119,251	2,239,161	4,771,235
Colorado	734,485	1,478,664	597,943	1,308,038
Connecticut	161,707	320,171	155,579	363,446
Delaware	14,747	8,848	14,049	8,429
Florida	691,570	926,492	368,556	543,836
Georgia	2,766,378	5,193,999	2,440,755	4,884,762
Idaho	11,116	18,133	9,295	10,348
Illinois	1,660,306	3,003,427	1,484,461	3,071,455
Indiana	1,393,483	2,393,666	1,065,897	1,828,468
Iowa	967,396	2,028,001	960,221	1,869,045
Kansas	1,169,264	1,489,564	1,310,576	1,785,130
Kentucky	940,316	1,040,364	731,428	870,596
Louisiana	978,523	1,329,396	770,254	1,425,260
Maine	40,773	74,418	146,333	182,716
Maryland	896,599	1,973,492	884,189	2,065,548
Massachusetts	217,053	404,472	217,685	378,780
Michigan	2,150,706	3,304,398	2,160,928	4,073,629
Minnesota	155,555	233,283	W	W
Mississippi	1,622,586	2,085,075	1,492,249	2,047,255
Missouri	1,564,697	2,370,701	1,541,656	2,890,768
Montana	42,337	65,734	58,624	97,696
Nebraska	158,468	285,761	182,394	413,878
New Hampshire	43,350	63,575	83,827	55,825
New Jersey	156,915	515,200	66,827	292,100
New Mexico	87,808	169,455	55,336	316,628
New York	1,798,912	2,146,185	1,450,564	2,348,006
North Carolina	4,109,174	5,057,166	3,421,825	4,648,355
Ohio	3,636,309	6,129,983	3,201,636	6,265,219
Oklahoma	1,297,699	1,871,026	1,288,938	2,105,382
Oregon	166,703	280,250	138,649	229,186
Pennsylvania	2,083,444	5,593,199	1,837,522	5,192,310
Puerto Rico	463,621	473,195	291,007	332,481
South Carolina	1,495,514	2,522,879	1,527,252	2,687,570
South Dakota	200,511	181,156	189,592	201,654
Tennessee	1,231,226	1,338,200	1,137,603	1,372,210
Texas	5,329,859	8,950,981	5,045,922	8,364,555
Utah	229,580	612,110	201,201	516,929
Virginia	1,645,726	1,885,774	1,956,746	2,618,820
Washington	286,538	663,873	269,425	698,235
West Virginia	347,833	516,300	338,817	520,315
Wisconsin	1,770	3,186	2,385	4,393
Wyoming	236,148	513,482	215,908	456,509
Other States [2]	87,648	178,018	289,104	523,839
Total	49,775,190	79,825,915	45,201,344	78,721,884

W Withheld to avoid disclosing individual company confidential data; included with "Other States."

[1] Includes Puerto Rico.

[2] Includes Hawaii, Nevada, North Dakota, and data indicated by symbol W.

Table 19.—Number of mines from which producers sold or used clay in the United States in 1974, by State [1]

State	Kaolin	Ball clay	Fire clay	Ben-tonite	Fuller's earth	Common clay and shale	Total [2]
Alabama	6	--	10	4	--	26	46
Arizona	--	1	1	3	--	6	11
Arkansas	4	--	--	--	--	16	20
California	6	1	6	10	3	52	74
Colorado	1	--	14	3	--	35	53
Connecticut	--	--	--	--	--	5	5
Delaware	--	--	--	--	--	1	1
Florida	3	--	--	--	5	4	12
Georgia	59	--	5	--	8	24	89
Hawaii	--	--	--	--	--	1	1
Idaho	--	--	1	--	--	4	5
Illinois	--	--	5	--	1	16	22
Indiana	--	--	3	--	--	26	27
Iowa	--	--	--	--	--	17	17
Kansas	--	--	--	--	--	25	25
Kentucky	--	4	12	--	--	13	29
Louisiana	--	--	--	--	--	15	15
Maine	--	--	--	--	--	6	6
Maryland	--	1	--	--	--	10	11
Massachusetts	--	--	--	--	--	3	3
Michigan	--	--	--	--	--	11	11
Minnesota	1	--	--	--	--	2	3
Mississippi	--	4	--	5	3	22	34
Missouri	10	--	81	1	1	21	113
Montana	--	--	1	10	--	10	21
Nebraska	--	--	--	--	--	6	6
Nevada	1	--	1	4	1	1	8
New Hampshire	--	--	--	--	--	3	3
New Jersey	--	--	4	--	--	2	6
New Mexico	--	--	2	--	—	7	9
New York	--	1	--	--	--	15	16
North Carolina	2	--	--	--	--	48	50
North Dakota	--	--	--	--	--	5	5
Ohio	--	--	32	--	--	82	108
Oklahoma	--	--	--	--	--	17	17
Oregon	--	--	--	4	--	13	17
Pennsylvania	2	--	36	--	--	45	74
Puerto Rico	--	--	--	--	--	3	3
South Carolina	21	--	--	--	1	37	58
South Dakota	--	--	--	2	--	4	6
Tennessee	--	33	--	--	1	21	51
Texas	2	7	4	14	1	93	115
Utah	2	--	2	3	1	9	17
Virginia	--	--	--	--	--	33	33
Washington	--	--	4	--	--	15	16
West Virginia	--	--	2	--	--	4	6
Wisconsin	--	--	--	--	--	1	1
Wyoming	--	--	--	435	--	4	439
Total	120	52	226	498	26	839	1,718

[1] Excludes Puerto Rico.
[2] Data may not add to totals shown because of mines having more than one kind of clay.

CONSUMPTION AND USES

The manufacture of heavy clay products (building brick, sewer pipe, drain, structural, and other tile), portland cement and clinker, and lightweight aggregate accounted for 37%, 20%, and 16%, respectively, of the total 1974 domestic consumption of clays. In summary, 74% of all clay produced in 1974 was consumed in the manufacture of these clay- and shale-based construction materials. The foregoing clay tonnage relationships were similar to those reported for 1973. The utilization of clays in 1974 for heavy clay products and portland cement decreased 8% and 5%, respectively, from that reported in 1973.

Heavy Clay Products.—The values reported for shipments of heavy clay products in 1974 declined 10% to $695 million from the 1973 value of $773 million. The trends in corresponding quantities were less consistent. Thousand-unit counts for building or common face brick decreased 23% in 1974 from those shipped in 1973 while shipments of glazed and unglazed ceramic tile and glazed brick and of clay floor and wall tile decreased 20% and 9%, respectively. The tonnage of unglazed structural tile increased 6%, and vitrified clay sewer pipe and fittings shipped during the year declined 21%. The value of these shipments, except for building brick and clay sewer pipe which decreased 17% and 3%, respectively, all remained unchanged.

Lightweight Aggregate.—Consumption of clay and shale in the making of lightweight aggregate declined in 1974 to 10,030,758 tons. This was a 14% decrease below the 11.7 million tons used in 1973, which was an alltime high.

The tonnage of raw material mentioned in tables 20 and 23 for lightweight aggregate production refers only to clay and shale and does not include the quantity of slate and blast furnace slag similarly used. In 1974, a total 983,196 tons of slate was expanded for lightweight aggregate, 10% below the 1973 figure of 1,092,021 tons. The National Slag Association reported the amount of expanded slag used for lightweight concrete aggregate and in block manufacture decreased 16% in 1974 from 1,560,000 tons in 1973 to 1,316,000 tons.

Refractories.—All types of clay were used in manufacturing refractories. Fire clay, kaolin, and bentonite accounted for 67%, 15%, and 13%, respectively, of the total clays used for this purpose. Bentonite was used primarily as a bonding agent in proprietary foundry formulations. Minor tonnages of ball clay (3%), fuller's earth, and common clay and shale (the remaining 2%) were also used, primarily as bonding agents.

The tonnage used for refractories in 1974 increased from 8% in 1973 to 9% of the total clays produced. This slight increase in the use of clay-based refractories continued for a third year, a reversal in the downward pattern set for a number of years. The increase was due primarily to both the continued expansion in refractory aggregate production and an upsurge in the manufacturing of more conventional brick-type refractories. Refractory aggregates are used mostly in plastic, gunning, ramming, and castable mixes.

Filler.—All clays are used to some extent as fillers in one or more areas of use. Kaolin and fuller's earth are the principal filler clays. Kaolin was used in the manufacture of a large number of products, such as paper, rubber, plastics, paint, and fertilizers. The other important filler clay, fuller's earth, was used primarily in pesticides and fertilizers. Clays in pesticides and fertilizers are used either as carriers, dilutents, or prilling agents.

Six percent of the clay produced in 1974 was used in filler applications. Kaolin accounted for 86%, and fuller's earth accounted for 6% of all the clay used for these purposes. The other clays accounted for the remaining 8%. The total amount of kaolin consumed by this end use category was essentially unchanged. In the individual categories, increases were recorded in paint (98%), paper filling (23%), fertilizers (22%), rubber (3%), and adhesives (2%). Decreases were noted in pesticides 1%, plastics 13%, paper coating 18%, and gypsum products 91%. Total quantity of fuller's earth used in insecticides and fungicides increased 2%.

Absorbent Uses.—Absorbent uses for clays, approximately 788,906 tons, consumed slightly more than 1% of the total 1974 clay production. Demand for absorbents in 1974 increased 9% from that reported for 1973. Fuller's earth was the principal clay used in absorbent applications; 97% of the entire output was consumed for this purpose. Bentonite was used to a lesser degree. Demand for clays in animal litter, representing 46% of the 1974 absorbent demand, increased 6% from that reported for 1973. Demand for use in floor absorbents, chiefly to absorb hazardous oily substances, represented the remaining 54% of absorbent demand and increased 11% from the 1973 figure.

Drilling Mud.—Demand for clays in rotary-drilling muds increased 7% in 1974, from 639,339 tons in 1973 to 681,755 tons. This increase in demand, mostly in exploratory gas well drilling and a lesser degree in oil well drilling, was spurred by the deregulation of "new" gas introduced into the interstate market after April 6, 1972. Drilling muds consumed slightly more than 1% of the entire 1974 clay production. Swelling-type bentonite is the principal clay used in drilling mud mixes, although fuller's earth or nonswelling bentonite is also used to a limited extent. Bentonite and fuller's earth accounted for nearly 100% of the total amount of clay used for this purpose. Small amounts of ball clay and common clay and shale were used in specialized formulations.

Floor and Wall Tile.—Common clay and shale, ball clay, fire clay, and kaolin, in order of demand, were used in manufacturing floor, wall, and quarry tile. This tile end use category accounted for less than 1% of the total clay production in 1974. Demand in 1974, 472,356 tons, increased 2% from that of 1973.

Pelletizing Iron Ore.—Bentonite is used as a binder in forming iron ore pellets. Demand, continuing the general trend, increased 12% in 1974 to 870,464 tons. This rise in the use of bentonite for iron ore pelletizing, reflecting an upturn in steel production, was accomplished in spite of inroads made by cheaper foreign bentonites into a traditional U.S. clay market. Of the total bentonite produced in 1974, about 32% of the swelling variety (an increase from 31% in 1973) was consumed for this purpose. U.S. deposits continued to be the major source for swelling bentonites.

Pottery.—The total demand for clays in the manufacture of pottery, sanitary ware, china/dinnerware, and related products, excluding clay flowerpots, accounted for 1% of the total 1974 clay output. The total clay demand, principally ball and kaolin clays rose slightly from 691,530 tons in 1973 to approximately 692,000 tons in 1974.

Table 20.—Clays sold or used by producers in the United States in 1974, including Puerto Rico, by kind and use

(Short tons)

Use	Ball clay	Bentonite	Common clay and shale	Fire clay (refractory only)	Fuller's earth	Kaolin	Undistributed [1]	Total
Adhesives	(2)	(2)	--	--	1,525	66,059	725	68,309
Alum (aluminum sulfate) and other chemicals	--	(2)	--	(2)	(2)	323,250	10,616	333,866
Animal feed	(2)	175,706	72	--	(2)	14,878	555	191,211
Asphalt emulsion and tiles	(2)	(2)	--	--	--	--	21,128	21,128
Building brick:								
Common	(2)	(2)	3,191,514	--	--	--	755	3,192,269
Face	13,000	2,922	17,288,521	105,257	--	425,328	--	17,830,028
Catalysts (oil refining)	(2)	4,879	--	--	(2)	69,936	16,171	90,986
Caulking, putty, sealers, glue	--	--	--	5	--	5,016	--	5,021
Cement, portland	--	459	11,966,555	--	19,690	134,275	--	12,120,979
Ceramic—hobby	--	--	--	--	--	647	--	647
China/dinnerware	43,291	--	--	--	--	21,555	--	64,846
Crockery and other earthenware	1,137	--	6,893	(2)	(2)	68,464	23,670	100,164
Drilling mud	4,663	599,688	1,428	--	75,976	--	--	681,755
Electrical porcelain	45,132	--	--	--	--	15,433	--	60,565
Fertilizers	--	6,490	8,443	--	54,516	88,087	--	157,536
Fiberglass	--	--	128	--	--	127,984	--	128,112
Filtering, clarifying, and decolorizing:								
Animal oils	--	68,271	--	--	--	--	--	68,271
Mineral oils and greases	--	23,533	--	--	31,128	(2)	--	[4]54,661
Vegetable oils	--	71,290	--	--	--	--	--	71,290
Firebrick, block, shapes	27,411	(2)	--	2,462,589	--	449,248	--	[4]2,939,248
Flower pots	--	--	47,366	--	--	--	--	47,366
Flue linings	--	--	99,789	57,141	--	(2)	--	[4]156,930
Foundry sand	--	738,055	--	229,395	--	5,372	--	972,822
Glazes, glass, enamels	1,969	209	--	50,688	--	5,240	--	58,106
Grogs and crudes, refractory	(2)	--	--	142,754	--	277,362	--	[4]420,116
Gypsum products	--	506	--	--	--	4,822	--	5,328
High alumina (minimum 50% Al_2O_3) refractories	22,019	--	--	348,540	--	60,501	--	431,060
Ink	--	--	--	--	--	14,162	--	14,162
Kiln furniture	9,349	--	--	250	--	2,245	--	11,844
Lightweight aggregate:								
Concrete block	--	--	5,989,308	--	--	--	--	5,989,308
Structural concrete	--	--	2,967,029	--	--	--	--	2,967,029
Highway surfacing	--	--	975,497	--	--	--	--	975,497
Other	--	--	98,929	--	--	--	--	98,929
Medical, pharmaceutical, cosmetic	2	14,878	--	--	16	1,986	--	16,882
Mortar and cement, refractory	(2)	--	--	432,761	(2)	1,855	72,235	506,851
Oil and grease absorbents	--	14,860	--	--	409,734	--	--	424,594
Paint	--	4,915	--	--	1,662	261,362	--	267,939
Paper coating	(2)	(2)	--	--	71	1,313,406	2,282	1,315,759

See footnotes at end of table.

Table 20.—Clays sold or used by producers in the United States in 1974, including Puerto Rico, by kind and use—Continued

(Short tons)

Use	Ball clay	Bentonite	Common clay and shale	Fire clay (refractory only)	Fuller's earth	Kaolin	Undistributed [1]	Total
Paper filling	(2)	(2)	--	--	--	1,012,129	13,760	1,025,889
Pelletizing (iron ore)	--	870,464	--	--	--	--	--	870,464
Pelletizing (other)	--	--	--	18,000	--	--	--	18,000
Pesticides and related products	(3)	23,853	--	--	179,579	28,511	--	[4]231,943
Pet absorbent	--	6,319	--	--	357,993	--	--	364,312
Plastics	--	--	--	--	(3)	54,275	--	[4]54,275
Plug, tap, and wad	--	--	--	9,592	--	--	--	9,592
Pottery	170,212	307	36,978	20,460	--	42,059	--	270,011
Rubber	400	--	100	--	--	378,602	--	379,102
Sanitary ware	174,701	(3)	--	--	--	82,774	--	[4]257,475
Sewer pipe, vitrified	--	100	1,502,508	106,102	--	--	--	1,608,710
Tamping dummies	--	--	7,680	--	--	--	--	7,680
Tile:								
Drain	--	--	434,413	--	--	--	--	434,413
Floor and wall, ceramic	88,474	--	142,769	65,998	--	17,082	--	314,323
Quarry	1,142	--	156,891	--	--	--	--	158,033
Roofing	--	13,129	83,534	--	--	--	--	96,663
Structural	--	--	64,591	--	--	--	--	64,591
Terra cotta	--	--	52,025	1,000	--	--	--	53,025
Waterproofing and sealing	(2)	86,295	--	--	(2)	3,554	6,230	96,079
Water treatment and filtering	--	--	11,651	--	--	--	--	11,651
Miscellaneous [5]	4,298	50,192	8,756	7,888	5,286	40,037	--	116,457
Undistributed	127,189	10,037	--	25,698	5,203	--	--	--
Exports	82,787	523,143	62,986	56,723	82,261	975,330	--	1,783,230
Total	817,176	3,310,500	45,201,344	4,140,841	1,224,640	6,392,826	(6)	61,087,327

[1] Total of clays indicated by footnote 2.

[2] Withheld to avoid disclosing individual company confidential data; included with "Undistributed."

[3] Withheld to avoid disclosing individual company confidential data; included with "Miscellaneous."

[4] Incomplete figure; remainder included with "Miscellaneous."

[5] Includes abrasives; graphite anodes; linoleum; mineral wool and insulation; roofing granules; textiles; unknown uses; and data indicated by footnote 3.

[6] "Undistributed" total included with total for each specific use.

Table 21.—Shipments of principal structural clay products in the United States

Product	1970		1971		1972		1973		1974	
	Quantity	Value (millions)	Quantity	Value (millions)	Quantity	Value (millions)	Quantity	Value (millions)	Quantity	Value (millions)
Unglazed common and face brick (million standard brick)	6,496	r $288	7,570	$346	8,402	$404	r 8,674	r $451	6,673	$376
Unglazed structural tile (thousand short tons)	181	6	r 157	4	101	3	94	4	100	4
Vitrified clay and sewer pipe fittings (thousand short tons)	1,622	119	1,721	133	1,713	143	r 1,647	r 133	1,454	134
Unglazed, salt glazed, and ceramic glazed structural facing tile, including glazed brick (million equivalent)	169	16	153	15	131	13	r 122	r 13	97	13
Clay floor and wall tile, including quarry tile (million square feet)	r 250	126	r 276	143	r 303	159	r 301	168	273	168
Total[1]	XX	554	XX	642	XX	722	XX	r 773	XX	695

r Revised. XX Not applicable.

[1] Data may not add to totals shown because of independent rounding.

Table 22.—Clay and shale used in building brick production in the United States in 1974, by State

State	Short tons	Value
Alabama	1,133,882	$1,725,994
Arizona and Hawaii	83,700	94,900
Arkansas	535,487	515,028
California	403,371	746,877
Colorado	358,744	920,636
Connecticut	146,879	346,133
Delaware	14,049	8,429
Florida	30,000	44,040
Georgia	2,208,446	4,313,507
Idaho	9,295	10,348
Illinois	459,407	1,192,425
Indiana	444,414	702,027
Iowa	243,120	381,041
Kansas	502,146	649,904
Kentucky	319,518	355,264
Louisiana	199,539	294,984
Maine and Maryland	418,799	1,280,387
Massachusetts and Michigan	207,476	316,153
Minnesota and Montana	56,512	90,338
Mississippi	1,146,018	1,600,611
Missouri	170,495	435,738
Nebraska	94,762	263,240
New Hampshire	33,827	$55,256
New Jersey	66,827	292,068
New Mexico and North Dakota	87,722	110,846
New York	274,241	521,968
North Carolina	2,584,605	3,490,979
Ohio	1,538,834	3,150,950
Oklahoma	602,148	1,001,041
Oregon	33,610	52,331
Pennsylvania	1,413,094	4,296,416
South Carolina	1,112,805	2,004,739
South Dakota	14,000	17,080
Tennessee	579,972	730,786
Texas	1,392,825	2,858,266
Utah and West Virginia	245,445	465,345
Virginia	1,103,716	1,547,640
Washington	142,239	300,898
Wisconsin	2,385	4,388
Wyoming	61,181	202,727
Total	20,475,085	37,891,728

Table 23.—Clay and shale used in lightweight aggregate production in the United States in 1974, by State and kind

State	Short tons					Total value
	Concrete block	Structural concrete	Highway surfacing	Other	Total	
Alabama and South Dakota	766,885	60,038	7,000	--	833,928	$999,135
Arkansas and Virginia	624,550	178,000	15,000	--	817,550	991,500
California	363,245	358,035	--	--	721,280	1,844,472
Colorado, Nebraska, Utah	268,801	121,601	--	78	390,480	712,382
Florida, Maryland, Massachusetts	512,190	89,200	--	--	601,390	1,036,713
Illinois, Indiana, Iowa	763,251	450,262	--	--	1,213,513	2,231,739
Kansas, Louisiana, Missouri	383,448	68,659	71,974	36,348	560,429	892,327
Kentucky, Michigan, Minnesota	256,097	49,725	--	40,243	346,065	487,272
Mississippi	287,372	24,236	34,623	--	346,231	446,638
Montana, North Dakota, Washington	55,609	--	--	--	55,609	89,720
New York	272,508	466,352	--	--	738,860	1,269,495
North Carolina, Ohio, Pennsylvania	437,200	365,800	--	--	803,000	1,116,081
Oklahoma	131,619	87,745	--	--	219,364	361,900
Oregon	29,773	6,236	--	--	36,009	90,023
Tennessee	164,436	134,400	--	--	298,836	371,700
Texas	672,319	506,740	846,900	22,260	2,048,219	2,830,169
Total	5,989,303	2,967,029	975,497	98,929	10,030,758	15,771,266

Table 24.—Shipments of refractories in the United States, by kind

Product	Unit of quantity	Shipments			
		1973		1974	
		Quantity	Value (thousands)	Quantity	Value (thousands)
Clay refractories:					
Superduty fire clay brick and shapes	Thousand 9-inch equivalent brick	r 68,263	r $26,730	77,771	$35,019
Other fire clay, including semisilica, brick shapes; glasshouse pots, tank blocks, feeder parts, and upper structure parts used only for glass tanks	do	r 234,687	r 55,483	252,546	69,707
High-alumina (50–60% Al_2O_3) brick & shapes made of calcined, diaspore or bauxite [1]	do	r 86,135	r 64,135	93,799	81,552
Insulating firebrick and shapes	do	r 53,358	r 18,332	59,468	22,825
Ladle brick	do	r 216,140	r 35,618	234,099	43,232
Sleeves, nozzles, runner brick, and tuyeres	do	r 59,259	r 21,393	51,338	23,738
Hot-top refractories	Short tons	r 27,677	r 2,571	31,971	2,918
Clay-kiln furniture, radiant-heater elements, potter's supplies, and other miscellaneous shaped refractory items	do	r 23,746	r 13,568	NA	13,140
Refractory bonding mortars	do	r 114,157	r 18,320	122,992	19,079
Plastic refractories and ramming mixes, containing up to 87.5% Al_2O_3 [2]	do	r 207,511	r 21,853	230,109	31,685
Hydraulic-setting insulating castable refractories	do	r 45,662	r 7,985	53,780	11,000
Other hydraulic-setting castable refractories	do	r 212,209	r 28,278	246,052	38,684
Other clay refractory materials sold in lump or ground form [3] [4]	do	r 453,117	r 12,999	405,815	17,574
Total clay refractories		XX	r 327,265	XX	410,153
Nonclay refractories:					
Silica brick and shapes	Thousand 9-inch equivalent brick	r 36,646	r 15,306	37,626	20,004
Magnesite and magnesite-chrome brick and shapes	do	r 109,881	r 145,683	117,209	178,840
Chrome and chrome-magnesite brick and shapes	do	r 19,964	24,420	20,726	30,536
Shaped refractories containing natural graphite	Short tons	r 18,430	r 18,391	22,561	28,868
Other carbon refractories: Forsterite, pyrophyllite, dolomite, dolomite-magnesite, molten cast and other brick and shapes [5]	Thousand 9-inch equivalent brick	r 36,584	r 72,644	40,418	97,085
Other mullite, kyanite, sillimanite, or andalusite brick and shapes	do	r 4,948	r 10,160	6,289	14,258
Other extra high-alumina (over 60%) brick and fused bauxite, fused alumina and dense-sintered alumina shapes [6]	do	r 2,996	r 11,433	4,148	16,475
Silicon carbide brick, shape and kiln furniture	do	r 4,730	r 20,296	5,272	25,644
Zircon and zirconia brick and shapes	do	r 2,387	r 8,785	2,708	11,380
Refractory bonding mortars	Short tons	r 48,222	r 8,686	60,250	12,245
Nonclay refractory castables, hydraulic-setting	do	r 61,850	r 15,655	47,406	14,656
Plastic refractories and ramming mixes	do	r 240,979	r 45,975	238,838	48,737
Gunning mixes	do	r 352,082	r 41,665	422,104	55,624
Dead-burned magnesia or magnesite [3] [7]	do	r 59,764	r 5,366	85,546	10,785
Other nonclay refractory materials sold in lump or ground form [3]	do	r 394,134	r 13,835	473,006	18,277
Total nonclay refractories		XX	r 458,300	XX	578,404
Grand total refractories		XX	r 785,565	XX	988,557

r Revised. NA Not available. XX Not applicable.

[1] Heated short of fusion, volatile materials thus being driven off in the presence of chemical changes, giving more stable material for refractory use.

[2] More or less plastic brick and materials which after the addition of water, if necessary, are rammed into place.

[3] Materials for domestic use as finished refractories, and all exported refractory material.

[4] Including calcined clay, ground brick and siliceous and other gunning mixes.

[5] Molten cast refractories are made by fusing refractory oxides and pouring molten material into molds to form finished shapes.

[6] Completely melted and cooled, then crushed and graded for use in a refractory.

[7] Includes shipments to refractory producers for reprocessing in the manufacture of other refractories.

Table 25.—Value of clay refractories shipped by consumer type

(Thousand dollars)

Industry	1973	1974
Ferrous metals (making, finishing and rolling, foundry and heat treating)	166,244	207,160
Nonferrous metals (primary and foundry)	16,796	23,177
Glass	11,706	11,594
Ceramics	35,590	43,774
Minerals processing	11,351	15,815
Chemicals and petrochemicals	12,125	10,523
Foreign	26,306	29,207
Other	47,147	68,903
Total	327,265	**410,153**

Table 26.—U.S. exports of clay by country and class in 1974

(Thousand short tons and thousand dollars)

Country	Bentonite		Fire clay		Fuller's earth		Kaolin		Ball clay		Clays, n.e.c.		Total [1]	
	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value
Angola	8	570	--	--	(2)	3	--	--	--	--	1	38	9	611
Argentina	1	93	(2)	16	1	37	6	500	--	--	12	752	20	1,398
Australia	57	1,407	1	96	(2)	15	5	123	--	--	32	2,134	95	3,775
Austria	(2)	2	--	--	(2)	4	(2)	13	--	--	8	841	8	860
Belgium-Luxembourg	3	497	2	69	4	294	6	348	(2)	2	4	331	19	1,541
Brazil	13	664	2	106	--	--	7	422	1	30	21	1,677	44	2,899
Canada	272	5,047	95	1,663	21	952	160	5,989	60	1,345	107	3,578	715	18,574
Finland	8	299	2	3	--	--	(2)	31	--	--	(2)	44	10	377
France	8	858	(2)	65	4	258	12	571	--	--	28	2,186	52	3,934
Germany, West	74	2,570	6	200	2	154	141	6,600	(2)	2	17	1,547	240	11,073
Guatemala	5	615	(2)	2	(2)	20	(2)	38	--	--	1	79	6	754
Italy	3	283	3	247	2	99	159	8,273	(2)	5	27	2,339	194	11,247
Japan	24	1,806	23	791	(2)	8	207	11,512	4	174	79	5,758	337	20,048
Mexico	1	102	76	1,858	(2)	6	38	1,864	58	1,037	8	329	181	5,197
Netherlands	38	1,294	4	179	5	241	37	1,921	--	--	18	1,283	102	4,918
Peru	2	405	(2)	4	(2)	10	1	58	(2)	11	2	97	5	585
Philippines	3	334	1	57	(2)	4	2	99	4	157	8	668	18	1,319
Saudi Arabia	23	1,531	1	66	--	--	--	--	--	--	(2)	34	24	1,631
Singapore	27	2,112	--	--	1	67	(2)	11	(2)	2	1	125	29	2,317
South Africa, Republic of	4	516	(2)	4	(2)	16	3	237	(2)	6	13	1,518	20	2,296
Sweden	(2)	105	(2)	43	(2)	128	11	525	(2)	7	3	224	14	1,032
Taiwan	5	330	(2)	3	(2)	3	(2)	4	--	--	14	804	19	1,144
United Kingdom	63	2,613	5	107	12	603	24	790	(2)	3	8	628	112	4,743
Venezuela	22	1,028	(2)	29	(2)	11	13	842	1	54	4	372	40	2,337
Other	50	3,710	3	375	4	300	17	1,309	3	103	61	3,805	138	9,602
Total	714	28,141	224	5,983	56	3,228	849	42,080	131	2,938	477	31,241	2,451	114,212

[1] Data may not add to totals shown because of independent rounding.
[2] Less than ½ unit.

Table 27.—U.S. imports for consumption of clay in 1974

Kind	Quantity (short tons)	Value (thousands)
China clay or kaolin, whether or not beneficiated:		
Brazil	8	(1)
Canada	867	$55
France	1	(1)
Japan	27	8
United Kingdom	18,208	687
Total	19,111	750
Fuller's earth, wholly or partly beneficiated: Mexico	1	(1)
Bentonite: Canada	40	1
Common blue and other ball clay, not beneficiated:		
Canada	2	(1)
United Kingdom	14,209	295
Total	14,211	295
Common blue or other ball clay, wholly or partly beneficiated:		
Netherlands	23	1
United Kingdom	8,596	148
Total	8,619	149
Clays, n.e.c., not beneficiated:		
Germany, West	23	3
Netherlands	67	30
Spain	--	1
Turkey	--	1
Total	90	35
Clays, n.e.c., wholly or partly beneficiated:		
Canada	30	3
Germany, West	178	22
Japan	417	106
United Kingdom	1,522	134
Total	2,147	265
Clays artificially activated with acid:		
Australia	5	4
Canada	853	42
France	1	1
Germany, West	186	28
Japan	1,863	562
Mexico	741	61
Total	3,599	698
Grand total	42,818	2,193

[1] Less than ½ unit.

WORLD REVIEW

Australia.—Certain assets of Quality Earths Pty. Ltd., a mineral processor based in Sydney, were purchased by Steetley Co., Ltd., of the United Kingdom. These operations were to be merged with those of its other Australian minerals subsidiaries, Australian Clays and Industrial Minerals Ltd. and Commercial Minerals Pty. Ltd., which include the mining and milling of kaolin, ball clay, and flint clay.[6] English China Clay Corp. (ECC) began producing coating quality kaolins in an Australian plant.[7] Bulk Minerals Pty. Ltd. (jointly owned by North West Oil and Minerals NL and Clarence Oil and Minerals), a bentonite producer, purchased 80 acres of land, buildings and a plant at Port Pirie in South Australia.[8]

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[6] Industrial Minerals. No. 79, April 1974, pp. 32–33.

[7] Hughes, R. E. Kaolin. Mining Engineering—1974 Annual Review. V. 27, No. 2, February 1975, pp. 76–77.

[8] Industrial Minerals. No. 85, October 1974, p. 50.

Table 28.—Kaolin: World production by country

(Thousand short tons)

Country [1]	1972	1973	1974 [p]
North America:			
Mexico	79	104	103
United States [2]	5,318	5,993	6,393
South America:			
Argentina	[r] 100	109	[e] 110
Brazil (beneficiated)	143	209	[e] 209
Chile	[r] 74	49	83
Colombia	111	[e] 111	[e] 116
Ecuador	[e] 1	1	1
Paraguay	4	9	13
Peru	1	[r] [e] 1	[e] 1
Europe:			
Austria (marketable)	99	91	[e] 91
Belgium [e]	110	110	110
Bulgaria	157	[e] 165	[e] 165
Czechoslovakia	465	496	[e] 496
Denmark [e]	20	20	20
France [3]	643	[r] [e] 650	[e] 650
Germany, West (marketable)	[r] 537	538	[e] 552
Greece	78	84	[e] 85
Hungary	72	91	[e] 91
Italy:			
Crude	76	80	99
Kaolinitic earth	17	24	25
Portugal	49	49	55
Romania [e]	55	55	96
Spain (marketable) [4]	[r] 149	150	[e] 150
U.S.S.R.[e]	2,200	2,300	2,300
United Kingdom	[r] 3,264	3,758	3,858
Africa:			
Algeria	5	7	10
Angola	1	1	[e] ([5])
Egypt, Arab Republic of	27	33	28
Ethiopia (including Eritrea)	29	[e] 30	[e] 30
Kenya	1	1	[e] 1
Malagasy Republic	2	2	4
Mozambique	2	([5])	[e] ([5])
South Africa, Republic of	42	43	54
Swaziland	2	2	2
Tanzania	2	1	1
Asia:			
Bangladesh	[e] 2	7	1
Hong Kong	3	7	4
India:			
Salable	317	282	311
Processed	129	125	116
Indonesia	7	33	29
Iran [6]	61	[r] [e] 83	[e] 110
Israel	32	[e] 32	5
Japan	[r] 140	440	456
Korea, Republic of	[r] 119	230	300
Malaysia	116	116	161
Pakistan	5	1	2
Sri Lanka	4	5	6
Taiwan [7]	18	23	[e] 23
Thailand	17	21	67
Turkey	22	26	[e] 26
Vietnam, South [e]	1	1	1
Oceania:			
Australia	72	[r] [e] 77	[e] 77
New Zealand	10	10	18
Total	[r] 15,010	16,886	17,715

[e] Estimate. [p] Preliminary. [r] Revised.

[1] In addition to countries listed, People's Republic of China, East Germany, Lebanon, Nigeria, Southern Rhodesia, and Yugoslavia also produced kaolin, but information is inadequate to make reliable estimates of output levels. Costa Rica, Guatemala, and Morocco produced less than 500 tons in each of the years covered by this table.

[2] Kaolin sold or used by producers.

[3] Includes kaolinitic clay.

[4] Excludes unwashed kaolin as follows in short tons: 1972—31,669; 1973—33,776; 1974—33,800 (estimated).

[5] Less than ½ unit.

[6] Year beginning March 21 of that stated.

[7] Data given are for ceramic and pottery clays.

Brazil.—Caulim Da Amazonia Ltda., located at Belem has acquired mining rights to an extensive deposit of proven high-grade kaolin. The company was erecting facilities, with a rated annual capacity of over 200,000 tons, to produce high-grade coating clays. The plant was scheduled for completion by late 1975 and shipments were expected to begin early in 1976. Euroclay (see section that follows on the Netherlands) was to provide distribution and technical services for marketing in Europe and Africa. Transportation of clay was to be by special bulk carriers on a fixed transport cycle.[9] In further kaolin activity the Kaolin Division of National Bulk Carriers, Inc., announced construction of its plant in the Amazon Basin and the Brazilian Government located and offered for sale another large kaolin deposit, 93 miles south of Belem on the Amazon River.[10]

France.—An agreement was concluded between Aluminium Pechiney (AP) and Aluminium Company of Canada, Ltd., a subsidiary of Alcan Aluminium Ltd., to set up a joint venture to construct a pilot plant near Marseilles to produce 20 tons of aluminum per day based on AP technology which uses raw materials other than bauxite. About $25 million was to be invested in the plant and it was due to be completed by mid-1976.[11]

Germany, West.—Morgan Refractories Ltd. of Neston, Chesire, and Thonwerke Ludwig KG of Koblenz have formed a joint company, Morgan Ludwig Feurfest GmbH, to manufacture and sell monolithic refractories.[12]

Guyana.—A longterm trade agreement was signed for the Government to supply kaolin, bauxite, and alumina (of unknown grade) to East Germany[13] and Japanese interests continued exploring and testing local kaolin clays.[14]

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[9] Industrial Minerals. No. 87, December 1974, p. 46.

[10] Work cited in footnote 7.

[11] European Chemical News. ECN New Projects—Contracts. V. 26, No. 666, Dec. 13, 1975, p. 18.

[12] Industrial Minerals. No. 79, April 1974, p. 46.

[13] Industrial Minerals. No. 80, May 1974, p. 40.

[14] Work cited in footnote 7.

Table 29.—Bentonite: World production, by country

(Short tons)

Country[1]	1972	1973	1974[p]
North America:			
Guatemala	--	--	2
Mexico	41,870	50,478	67,445
United States	2,766,998	3,072,542	3,310,500
South America:			
Argentina	[r] 118,084	112,048	[e] 112,400
Brazil	42,092	[e] 44,100	[e] 44,100
Colombia	[e] 1,100	1,823	1,102
Peru	6,170	[r] [e] 6,170	[e] 6,170
Europe:			
France	15,460	[r] [e] 15,430	[e] 15,430
Greece	418,822	520,543	[e] 523,600
Hungary	87,082	80,470	[e] 80,470
Italy	[r] 301,154	329,974	379,089
Poland [e]	55,000	55,000	55,000
Romania [e]	[r] 55,000	[r] 55,000	69,200
Spain	47,526	52,502	[e] 52,900
Africa:			
Algeria (bentonite clay)	21,947	24,802	[e] 24,800
Morocco	9,590	6,815	3,652
Mozambique	2,637	2,660	[e] 1,100
South Africa, Republic of	26,799	27,646	42,773
Asia:			
Burma	[r] 683	927	560
Cyprus (bentonite clay)[2]	12,038	9,794	5,040
Iran	19,842	38,581	55,116
Israel (metabentonite)	2,205	4,409	4,189
Pakistan	530	1,069	1,010
Philippines	67	--	--
Turkey	[e] 5,500	8,613	[e] 8,800
Oceania:			
Australia[3]	434	[r] [e] 440	[e] 440
New Zealand (processed)[4]	683	1,136	1,206
Total	[r] 4,054,263	4,521,972	4,866,094

[e] Estimate. [p] Preliminary. [r] Revised.

[1] In addition to the countries listed, Austria, Canada, the People's Republic of China, West Germany, Japan, and the U.S.S.R. are believed to have produced bentonite, but output is not reported and available information is inadequate to make reliable estimates of output levels.

[2] Exports.

[3] Including bentonitic clay.

[4] In 1974, 4,382 short tons of unprocessed bentonite was reported among the mineral products of New Zealand; this is apparently in addition to the reported tonnages of processed bentonite. Comparable figures for 1972 and 1973 are not available.

Table 30.—Fuller's earth: World production
(Short tons)

Country[1]	1972	1973	1974 [p]
Algeria [e]	66,000	66,000	66,000
Argentina	528	394	[e] 390
Australia [2] [e]	[r] 110	[r] 110	110
Italy	82,662	125,225	116,073
Mexico	33,501	55,449	59,372
Morocco (smectite)	17,017	21,078	22,150
Pakistan	12,397	12,505	17,216
Senegal (attapulgite)	3,405	8,849	10,774
South Africa, Republic of	2,091	1,010	[e] 990
United Kingdom [e]	193,000	193,000	193,000
United States	988,538	1,138,433	1,224,640
Total	[r] 1,399,249	1,621,553	1,710,715

[e] Estimate. [p] Preliminary. [r] Revised.

[1] In addition to the countries listed, France, Iran, Japan, and Turkey have reportedly produced fuller's earth in the past and may continue to do so, but output is not reported and available information is inadequate to make reliable estimates of output levels. Similarly, no information is available on output in the centrally planned economy nations of Europe and Asia, but at least some of them also are presumably producing fuller's earth.

Hungary.—Large reserves of bentonite and kaolin were reported in the northeastern part of the country. The clays, found in hydrothermally altered rhyolite tuffs, were reported to be of high quality.[15]

Iran.—A $1.1 million contract has been awarded to Swindell-Dressler Co., a division of Pullman, Inc., by Iran Refractories Co. (IRC), for shuttle kilns and car-moving equipment for a refractory plant. IRC is a joint venture between Iranian partners and Harbison-Walker Refractories, Inc. (HWR). The new plant, designed by HWR was to have a rated capacity of 26,000 short tons, including a complete range of fire clay, high alumina, and basic refractory bricks for the Iranian market.[16]

Italy.—Production of activated bentonite was started at Süd-Chemie, Italia's new plant at Giba, Sardinia. The plant which took 1½ years to build is a subsidiary of Süd-Chemie, Munich.[17]

Malaysia.—The increased production of kaolin has come as the result of a new operation at Tapah in Perak State. This operation, which produces waterwashed grades, is controlled by a consortium of Japanese and Malay interests headed by Sanyo Pulp Co., a major Japanese consumer of kaolin and filling and coating grades.[18]

Netherlands.—Euroclay Handelmaatschappy BV of Rotterdam (owned by Georgia Kaolin Co. and Amberger Kaolinwerke GmbH of West Germany) has agreed to distribute paper-coating-quality kaolins produced by Caulim Da Amazonia Ltda. of Belem, Brazil, in Europe and Africa. Euroclay for years has provided the European paper industry with American coating clays, and the new agreement signifies an extension of its marketing program. Euroclay's decision was made to ensure long-term continuous supplies of high-quality American paper coating clays. Additional facilities were to be provided at the port of Rotterdam and at unspecified inland water sites to handle this new production from Brazil.[19] The Refractories Division of the Gibbons Dudley group moved into the European refactories market by acquiring a 50% interest in the Netherlands producer, Chamotte-Unie NV and forming a new company, Chamotte Gibbons Continental.[20]

South Africa, Republic of.—Octavi Mining Co. (Pty.) Ltd., a ceramics and refractory producer, planned to manufacture refractory brick and expand production of castables, moldables, etc., at its Belfast plant in Eastern Transvaal.[21] English China Clays South Africa (Pty.) Ltd. has opened an office in Pretoria with plans to beneficiate local clays and produce refractories for local markets.[22]

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[15] Molnar, J. Eastern Europe—Hungary. Annual Mining Review, 1975. Min. Mag. (London), 1975, pp. 508–513.

[16] Journal of Metals. Metallograms—Swindell-Dressler Gets $1.1 Million Iranian Contract. V. 26, No. 7, July 1974, p. 10.

[17] European Chemical News. ECN Market Report –In Brief. V. 27, No. 673, Feb. 7, 1975, p. 26.

[18] Industrial Minerals. No. 78, March 1974, p. 42.

[19] Industrial Minerals. No. 87, December 1974, p. 49.

[20] Work cited in footnote 12.

[21] Industrial Minerals. No. 85, October 1974, p. 51.

[22] Industrial Minerals. No. 86, November 1974, p. 44.

Turkey.—The country's visible and probable reserves of kaolin were reported as 150 million tons. Geological mapping on which mineral exploration and these reserves were based was an undertaking of the Mineral Research and Exploration Institute.[23]

United Kingdom.—English China Clay Ltd. (ECC) of St. Austell commissioned new refining, drying, and calcining plants and completed a plan covering river pollution. The river pollution plan involved constructing a 300 feet high dam at Kernick, comparable in height with the highest earth dam water reservoir in the United Kingdom, to settle some 3 million tons per year of micaceous residue associated with a production of 2.5 million tons of china clay. ECC was also expanding production of its calcined clay extender line, owing to the world shortage of TiO_2. Watts, Blake and Bearne and Co., Ltd., which has china and ball clay operations, mainly in Devon, was installing a new ball clay processing plant.[24]

In another undertaking, ECC acquired a 50% interest in International Drilling Fluids, excluding its activities in the United States and Canada. The company was formerly a wholly-owned subsidiary of Trans-Canada Resources of Calgary and is a major supplier of drilling mud.[25] Trans-Canada has a strong technical background and supplies engineering services and materials in the United Kingdom (both on and offshore) and overseas, including Spain, Portugal, the Netherlands (offshore), and the Middle East. As a consequence of this joint venture, the new company, International Drilling Fluids (U.K.) Ltd. will cover operations on and offshore in the United Kingdom and Ireland.[26]

Venezuela.—The Guyana Kaolin Co. built a processing plant south of the Eldorado River. The grade, rated capacity and destination of the plant output were unspecified.[27]

TECHNOLOGY

The U.S. Bureau of Mines and eight aluminum producers cosponsored research on extracting alumina from domestic materials that are plentiful, which could ease our dependence on imported bauxite. Using mini-pilot plant facilities at the Boulder City (Nev.) Metallurgy Laboratory, researchers were to investigate several methods for extracting alumina from clays, anorthosite, alunite, and dawsonite. Each participating company was to contribute $50,000 per year over the next 3 years to the program, and the cost to the Bureau was to be $400,000 per year.

Current work was proceeding on a Georgia kaolin using a nitric acid leaching process. Hydrochloric acid leaching of clay was scheduled for testing next, followed by anorthosite. The experimental miniplant, operational around the clock, can convert about 70 pounds of clay per hour to 25 pounds of alumina.[28]

A proposed timetable and funding for the Bureau's alumina miniplant program, with and without a cooperative effort, was published.[29] This publication also included a comprehensive treatise on the state of aluminum, the highlights of Bureau of Mines investigations on alumina from clays and other domestic sources, and a review of prior publications. In another work, the Bureau released revised and updated cost estimates for producing alumina from domestic raw materials by the nitric acid-ion exchange, hydrochloric acid-isopropyl ether extraction, potassium alum, and lime soda sinter processes.[30]

In a related work, the Georgia Department of Community Development under a grant from the Coastal Plains Regional Commission updated an earlier 1972 publication by issuing a detailed report on recovering alumina from Georgia kaolins.[31]

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[23] U.S. Embassy, Ankara, Turkey. State Department. Airgram A-108, June 5, 1974, 2 pp.

[24] Shrimpton, J. Western Europe—United Kingdom. Annual Mining Review, 1975. Min. J. (London), 1975, pp. 469–474.

[25] European Chemical News. Company Finance-Finance Briefs. V. 26, No. 649, Aug. 16 1974, p. 31.

[26] Mining Magazine (London). Briefly From Industry. V. 131, No. 5, November 1974, p. 407.

[27] Work cited in footnote 7.

[28] U.S. Bureau of Mines. Mines Bureau's Aluminum "Mini-Plant" Gets Eight Co-Sponsors for Research. Press Release, Oct. 10, 1974, 1 p.

[29] U.S. Bureau of Mines. Alumina From Domestic Resources. A Miniplant Project to Evaluate Alumina Recovery Processes, 1974, 29 pp. and appendixes; available from Division of Metallurgy, Bureau of Mines, Washington, D.C.

[30] Peters, F. A., and P. W. Johnson. Revised and Updated Cost Estimates for Producing Alumina From Domestic Raw Materials. BuMines IC 8648, 1974, 51 pp.

[31] Ward, W. C., Jr., and J. E. Husted. Alumina From Kaolin. Industrial Development Div., Engineering Experiment Station, Georgia Inst. of Technol. Athens, Ga., Project A-1458, November 1974, 45 pp.

The work dealt in depth with significant events since 1972, Georgia kaolin reserves, potential processing methods, energy requirements and availability, water requirements and availability, transportation availability, and environmental considerations. A proposed State Constitutional amendment, and a sample ballot for referendum was included in an appendix. The amendment proposed a financial incentive to the first commercial producer of alumina or aluminum chloride from Georgia's vast kaolin deposits. Another evaluation of alternative methods of producing aluminum from non-bauxite ores was put forth. The discussion, including flowsheets, was concerned only with the Alcoa smelting, the Alcan, the monochloride, and the Toth processes.[32] A brief review was also attempted for those alumina from non-bauxitic ores projects that have reached, or are near to reaching a semicommercial stage of production.[33]

A review presented a survey of the past, present, and future of high-intensity wet magnetic separation (HGMS).[34] The principles involved were discussed, and the fundamental limitations on metallurgical performance were developed along with the influence of the liberation characteristics of the ore on separator performance. This review also traced the historical evolution of HGMS designs and depicted some of the currently available commercial separators. Another theoretical review article on HGMS was published.[35] Assessment of HGMS equipment and processing technology of the recently developed units was analyzed.[36] This work, while highlighting the removal of contaminants from kaolin slurries, also related this technology to the beneficiating of other industrial minerals, concentrations of metallic ores, desulfurization of coal, and cleanup of effluent streams.

The properties, handling, and economics of kaolin slurries used by the paper, paint, and rubber-plastics chemists were discussed.[37] A similar work was published on the role of fillers in plastics composites.[38] A treatise in three sections, mineralogy, deposits, and use of kaolins, was added to the literature.[39] The mineralogy section emphasized the difficulties encountered in classifying the kaolinite group of minerals and gives details of the various characterization methods used. The section concerned with deposits deals with the origin of the ores, without discussing genetic characteristics. The section on uses deals with economics which specifies the different grades required by users, and also gives information on the use of kaolins, especially in the paper industry. An identical work, highlighting the paper kaolins was added to the French literature.[40]

Newly designed stability diagrams coupled with a thermodynamic treatment show that in average river water halloysite and kaolinite are stable with respect to K-feldspar, albite, and nepheline. By contrast in present seawater, kaolinite alone is stable in a system containing kaolins plus K-feldspar or albite but both halloysite and kaolinite are stable in a system of kaolins and nepheline. Geological occurrences of kaolinite and halloysite in modern and ancient weathered products are consistent with these theoretical interpretations.[41] Addition of quercetin, an organic flavone ($C_{15}H_{10}O_7$), to aqueous solutions containing silica and aluminum and adjusted to final pH's from 6.5 to 8.5 produced a 1:1 aluminosilicate precipitate which, after 6 to 16 months of aging in solution at 25° C, contained as much as 5% well-formed kaolin plates.[42] Similar solutions containing no organic material produced relatively amorphous precipitates with the same composition and stability but with substantially smaller amounts of crystalline material even after 2 years of aging. The

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[32] Peacey, J. G., and W. G. Davenport. Evaluation Alternative Methods of Aluminum Production. J. of Metals, v. 26, No. 7, July 1974, pp. 25.

[33] Industrial Minerals. No. 78, March 1974, pp. 32–33.

[34] Sawyer, J. E., and D. M. Hopstock. Wet magnetic Separation of Weakly Magnetic Minerals. Min. Sci. Eng., v. 6, No. 3, July 1974, pp. 154–172.

[35] Gaudin, A. M. Progress in Magnetic Separation Using High-Intensity, High-Gradient Separators. Min. Congress J., v. 60, No. 1, January 1974, pp. 18–21.

[36] Iannicelli, J. Assessment of High Extraction Magnetic Filtration. June 17, 1974. Prepared with support of the National Science Foundation (RANN) ISRU, Washington, D.C.

[37] Van Buren, R. Kaolin Slurries: Properties, Handling Economics. Am. Paint J., v. 58, No. 36, Feb. 18, 1974, pp. 54–58.

[38] Seymour, R. The Role of Fillers in Composites. CHEMTECH, July 1974, pp. 422–425.

[39] Dimanche, F., A. Rassel, P. Tarte, and J. Thores. The Kaolins: Mineralogy, Deposits, Uses. Min. Sci. Eng., v. 6, No. 4, October 1974, pp. 184–205.

[40] Dimanche, F. Les Kaolins papetiers: Leur Cadres geologiques et les Techniques d'Appreciation. Silicates Industriels, v. 39, No. 4, April 1974, pp. 117–120.

[41] Huang, W. H. Stabilities of Kaolinite and Halloysite in Relation to Weathering of Feldspars and Nepheline in Aqueous Solution. Am. Mineralogist, v. 59, Nos. 3–4, March–April 1974, pp. 365–371.

[42] Hem, J.D., and C. J. Lind. Kaolinite Synthesis at 24° C. Science, v. 184, No. 4142, June 14, 1974, pp. 1171–1173.

1.9 infrared band of kaolinite clay, due to the H-O-H bending made of water, variable in clays, was shown to be dependent on the hydration state of the clay.[43] These three papers should help clarify the geological mode of formation of kaolin group clays. The phases in the kaolinite-mullite reaction sequence were reexamined by infrared absorption spectrophotometry.[44] This work appears to eliminate the uncertainty about the identity of the Al-containing phase intermediate between metakaolinite (formed on dehydroxylation at≈500° C) and mullite (forming at≈950° C). The new phase was identified as an Al-Si spinel. This work should contribute to the more efficient calcining of kaolins and producing refractory mullite grogs and crude aggregates from kaolin-bauxite mixtures.

A technique for identifying the fabric of kaolin clay by measurement of the monochromatic light intensity emanating from the analyzer of a polarizing microscope was described and evaluated analytically and experimentally.[45] This technique should help researchers in relating various phenomenological response characteristics (deformation resistance, permeability, etc.) of clay soils to their fabrics, or the geometrical relationships among individual particles or groups of particles. The kinetics of the adsorption of 2, 4–D from aqueous solution by Wyoming bentonites and their distribution within the clay's sheet structure was investigated.[46] The knowledge of these adsorption processes will aid in predicting the distribution of herbicides and fertilizers in the soil and aquatic environments.

Synthetic hectorite, purer than the natural clay was made from a relatively cheap and abundant natural source material, Montana talc. This method, reportedly cheaper than existing methods, involves calcining a talc and lithium oxide mixture at 1,400° to 1,800° F and then mixing with an aqueous solution of sodium silicate and carbonate (or hydroxide or bicarbonate) in given ratios. Autoclaving, follows from 8 to 16 hours, to give a desired clay composition—Si_{18} $Mg_{5.3}$ $Li_{0.66}(OH)_4$ O_{20} $Na_{0.66}$—with fluorine replacing some of the hydroxide group. The hectorite product gives a desirable rheology for oil thickening in mud, paint, and grease.[47]

A detailed discussion of Australian kaolin deposits in New South Wales, Victoria, South Australia, Queensland, Western Australia, and Tasmania were highlighted.[48] Included in the discussion was a State-by-State kaolin production table from 1967 to 1971 and a breakdown of its uses in Australian industry: Ceramics, 33.5%; refractories, 32.0%; paper, 24%; rubber, 4.5%; paint, 2.8%; and others, 3.2%.

The geomorphology, geological structure, stratigraphy, and economic geology of the Meigs-Attapulgus-Quincy district in Georgia and Florida, the leading producer of fuller's earth in the United States, was published.[49] A guidebook was prepared for a field conference sponsored by the Society of Economic Geologists (SEG) Inc. prior to the joint meeting of the SEG with the Geological Society of America, Miami, Fla., November 14–16, 1974.[50] The book dealt with the kaolin of the Macon-Gordon area (Georgia) and the fuller's earth of the Meigs-Attapulgus-Quincy district, in Georgia and Florida. The fuller's earth section was similar to the one referenced in footnote 49. The kaolin section covered the stratigraphy, structure, deposits, and preparation of kaolin for marketing in the area. Discussion of the kaolin deposits included definition and mineralogy, occurrence, origin, and exploration and evaluation of selected deposits. The preparation segment touched on mining, beneficiation, and uses and production.

A detailed discussion of modern refractory maintenance procedures for kilns was highlighted.[51] The discussion included sections on the planning, purchasing, receiving and storage, removal of old lining, installation of new lining, warmup, and operation. The installation section dealt with brick, castables, and plastics refractories. These refractories are usually clay-based materials. A similar in-depth study of furnace, ladle, pouring pad, nozzle, tundish, and pouring refractories for continuous casting of steel[52] was detailed in another article. The paper described changes in refractory technology involved in making continuous casting successful, discusses current patterns in refractory consumption, and predicts future trends.

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[43] Lindberg, J. D., and M. S. Smith. Visible and Near Infrared Absorption Coefficients of Kaolinite and Related Clays. Am. Mineralogist, v. 59, Nos. 3 4, March–April 1974, pp. 274–279.

[44] Percival, H.J., and J. F. Duncan. Interpretation of the Kaolinite-Mullite Reaction Sequence From Infrared Absorption Spectra. J. Am. Ceram. Soc., v. 57, No. 2, February 1974, pp. 57–61.

[45] Shuran, D. E., and R. J. Krizek. A Spectrophotometric Technique for the Fabric Analysis of Mono-Mineralic Kaolinitic Soils. J. Testing and Evaluation, v. 2, No. 5, September 1974, pp. 323–329.

[46] Khan, S. V. Adsorption of 2, 4–D From Aqueous Solution by Fulvic Acid-Clay Complex. Environ. Sci. and Technol., v. 8, No. 3, March 1974, pp. 236–238.

[47] Mining Magazine (London). Industrial Mineral Abstracts. V. 130, No. 4, April 1974, p. 324.

[48] Industrial Minerals. No. 76, January 1974, pp. 17–18.

[49] Patterson, S. H. Fuller's Earth and Other Industrial Mineral Resources of the Meigs-Attapulgus-Quincy District, Georgia and Florida. U.S. Geol. Survey Prof. Paper 828, 1974, 45 pp. (with maps).

[50] Patterson, S. H., and B. F. Buie. Field Conference on Kaolin and Fuller's Earth, Nov. 14–16, 1974, Miami, Fla., of the Society of Economic Geologists, Inc. Guidebook 14, pub. by the Georgia Geological Survey, Atlanta, Ga., 1974, 53 pp.

[51] Drenkel, M. Efficient and Safe Maintenance Producers for Refractories. Pit and Quarry, v. 67, No. 4, October 1974, pp. 114–124.

Substantial savings in lightweight aggregate fuel costs were realized by grate coolers and kiln internals with significantly reduced heat losses.[53] Pyroprocessing in a 12- by 250-foot rotary kiln used primarily for lightweight aggregates for antiskid material in rigid as well as flexible road surfaces was published.[54] The article included a detailed flowsheet for an expanded plant. In a related work, briquetting of rejected shale fines provided a substantial additional feed source for lightweight aggregate production.[55]

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[52] Kappmeyer, K. K., C. K. Russel, and D. H. Hubble. Refractories for Continuous Casting. J. of Metals, v. 26, No. 7, July 1974, pp. 29–36.

[53] Biege, N. W., and S. M. Cohen. Cutting Lightweight Aggregate Fuel Costs. Rock Products, v. 77, No 11, November 1974, pp. 50–51, 68–70.

[54] Levine, S. Superock Expands Shale for Highways. Rock Products, v. 77, No. 4, April 1974, pp. 42–44.

[55] Murphy, D. T. Briquetting Reclaims Fines. Rock Products, v. 77, No. 4, April 1974, p. 45.

Coal—Bituminous and Lignite

By L. W. Westerstrom [1] and R. E. Harris [2]

CONTENTS

Tables — *Page*

Salient statistics ---------------- 352
Reserve base ------------------ 353
Annual average heat values ------ 354
Production:
  Weekly ------------------ 355
  Monthly ------------------ 356
  By type of mining ---------- 357
  By State ------------------ 357
  By county ----------------- 367
  By district ---------------- 367
  By size of mine ------------ 364
Energy consumed -------------- 404
Underground mine operations ---- 376
Surface mine operations -------- 382
Preparation:
  Cleaning ------------------ 385
  Crushing or screening ------- 387
  Drying -------------------- 387
Shipments:
  By railroad and waterway ---- 389
  By unit train -------------- 391
  By sulfur content ---------- 405
Distribution ------------------ 394
Employment and productivity:
  By State ------------------ 358
  By district ---------------- 359
Consumption and stocks --------- 392
Mine value:
  By State ------------------ 360
  By district ---------------- 361
  By county ----------------- 367
Exports ---------------------- 399
Imports ---------------------- 401
World production -------------- 402

DOMESTIC PRODUCTION

Bituminous coal and lignite production increased from 591.7 million tons in 1973 to 603.4 million tons in 1974. Despite the increase, an estimated loss in annual production of about 25 million tons occurred in 1974 because of a miners' strike in November and December during negotiations of a new wage agreement. In addition to the strike interruption, activities in the coal industry were unsettled because of uncertainties in the overall energy market resulting from tightened supplies of oil and natural gas and constraints on coal production from environmental requirements pertaining to air pollution and surface mining.

Underground production declined 22 million tons in 1974, primarily owing to the strike which had a much greater impact on output from deep mines than on that from surface mines. Surface mine production increased 34 million tons and accounted for 54% of total production. In 1974 production increased in nearly all Western States, but declined in most Eastern States.

This survey includes all bituminous coal produced in the United States except production from mines that produced less than 1,000 tons per year. All quantity figures represent short tons of marketable coal and exclude washery and other refuse. Statistics are final and based upon detailed annual reports of production and mine operation furnished by producers. For production not directly reported (chiefly that of small mines), accurate data were obtained from the records of State mine departments, which have statutory authority to require such reports. Thus, complete coverage of all mines producing 1,000 tons per year or more is reported.

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[1] Industry economist, Division of Coal.
[2] Mining engineer, Division of Fuels Data.

The weekly and monthly estimates of production, summarized in tables 6 and 7, are based upon car-loadings of coal reported weekly by railroads, river shipments reported by the U.S. Army Corps of Engineers, reports from mining companies, and monthly production statements compiled by local operators' associations and State mine departments.

Employment increased from 148,000 men in 1973 to 167,000 men in 1974. Coal production per man per day for all miners of 17.58 tons in 1974 was identical to productivity in 1973 despite decreases in both underground and surface mine productivity. This occurred because of the large percentage increase in surface mine production.

CONSUMPTION AND DISTRIBUTION

Tables 40–45 summarize shipments of coal and lignite in 1974. Table 45 shows the quantitative changes in total tons by geographic division and States of destination from 1970 through 1974. The distribution data by consumer use do not necessarily conform to the consumption data because the latter represents actual use at consumers' facilities, whereas the distribution data represent shipments from mines, some of which were in transit or in consumers' storage. These distribution data are based on reports submitted quarterly to the Bureau of Mines by producers, sales agents, distributors, and wholesalers, who normally produce or sell 100,000 tons or more annually. Their reported tonnage accounted for 92% of the coal produced or shipped in 1974. To account for total industry shipments, estimates for the remaining shipments are included, based on data from the Federal Power Commission and other reliable coal statistical reporting agencies. Additional details of bituminous coal and lignite distribution for 1974 were published by the Bureau of Mines.[8]

PRICES

A combination of factors drove f.o.b. mine prices of coal sharply upward in 1974. The Arab oil embargo of 1973–74 resulted in a considerable increase in demand for coal and consequent higher prices. Imbalances in supply and demand were aggravated by distress buying in anticipation of the miners' strike late in 1974. The average f.o.b. mine value of coal increased from $8.53 per ton in 1973 to $15.75 per ton in 1974. The average price of coal at underground mines increased from $10.84 per ton in 1973 to $19.86 per ton in 1974. The average price at strip mines increased from $6.11 per ton in 1973 to $11.11 per ton in 1974. The average rail freight charge on coal increased from $3.71 per ton in 1973 to $4.71 per ton in 1974.

FOREIGN TRADE

In 1974, the United States exported 59.9 million tons of coal, an increase of 7 million tons compared with exports in 1973. Japan maintained its position as the principal U.S. foreign market with a 45.6%, share of total U.S. coal exports. Shipments of coal to Canada, Europe, and South America accounted for 22.9%, 26.5%, and 3.9%, respectively.

There was a 5-million ton increase in coal shipped from eastern coal producing districts in 1974. Shipments of higher sulfur coals from midwestern producing districts declined 8 million tons. Total shipments from Western States increased 15 million tons.

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[8] Bureau of Mines. Bituminous Coal and Lignite Distribution for Calendar Year 1974. Mineral Industry Survey, Apr. 18, 1975.

TECHNOLOGY

Coal mining research is currently aimed at increasing productivity and unit operating capacities of mining systems without causing any adverse impacts on safety or the environment. Toward this end, the Bureau of Mines in 1974 began an intensive and long-range coal extraction and exploration program. Because of the geographic and stratigraphic distribution of coal resources, a continuing production mix from both surface and underground mining is needed. Accordingly, the near-term goal of the program is to develop technologies that will result in significant increases in production, productivity, and coal recovery with the present surface and underground mining methods.

In exploration research, emphasis is being placed on securing more definitive geologic and geochemical data on many coal deposits, particularly those in Western States. Although coal reserves are adequately identified for short-term policy and production needs, these data are needed to provide industry with better knowledge on which to base regional mining extraction plans, and also to assess factors that will determine the environmental impact of mining.

The environmental studies area will concentrate on developing criteria to measure the impact of mining on the ecosystem. Most of the environmental protection technology research will be integrated within the new mining system projects.

The major goals in the mining technology program are to increase the average production per shift from both conventional and continuous mining methods by increasing the reliability of existing equipment and to improve productivity substantially by automating or remote controlling as many operations as possible; to accelerate the use of longwall mining to increase the percentage of coal recovered and to mine efficiently and safely coal deposits at greater depths and under difficult strata conditions; to recover methane from the coal seam prior to mining to speed production by eliminating methane problems, and to make use of the methane; to develop mining systems that can economically recover 80% or more of thick and steeply pitching seams of coal in certain western deposits; to develop the technology to provide adequate protections of the surface environment from underground mining such as subsidence and water contamination; and to reduce the time required to open new mines and bring them to full production.

The Bureau of Mines major goal in advancing surface mining technology involves the integration of excavation and reclamation systems in order to reduce the environmental impact. Equipment developments will be undertaken where specialized needs are identified that would improve the efficiency of mining and reclaiming the surface. The Bureau is also exploring the feasibility of improving efficiencies of present large stripping equipment by automating the dig-haul-dump-spread cycle. Reclamation techniques are being developed that will be particularly adaptable to the arid and semiarid western coal regions.

Table 1.—Salient statistics of the bituminous coal and lignite industry in the United States

Item	1970	1971	1972	1973	1974
Production ----- thousand short tons --	602,932	552,192	595,386	591,738	603,406
Value ---------------------- thousands --	$3,772,662	$3,904,562	$4,561,988	$5,049,612	$9,502,347
Consumption -- thousand short tons --	515,619	494,862	516,776	556,022	552,709
Stocks at yearend:					
Industrial consumers and retail yards ---- thousand short tons --	92,275	89,985	116,500	r 103,022	96,528
Upper lake docks ---------- do ----	1,468	1,205	939	822	1,051
Exports [1] ----------------------- do ----	70,944	56,633	55,997	52,903	59,926
Imports [1] ----------------------- do ----	36	111	47	127	2,080
Price indicators, average per net ton:					
Cost of coking coal at merchant coke ovens ----------------------	$12.27	$15.26	$17.67	$19.77	$34.20
Railroad freight charge [2] ----------	$3.41	$3.70	$3.67	$3.71	$4.71
Value f.o.b. mines (sold in open market) -------------------	$5.89	$6.66	$7.35	$8.06	$15.16
Value f.o.b. mines ------------------	$6.26	$7.07	$7.66	$8.53	$15.75
Method of mining:					
Hand-loaded underground thousand short tons --	9,599	4,992	2,974	1,970	710
Mechanically loaded underground do ----	329,189	270,896	301,129	297,384	276,599
Percentage mechanically loaded ----	97.2	98.2	99.0	99.3	99.7
Percentage cut by machine --------	46.1	40.6	37.4	35.8	33.0
Mined by surface thousand short tons --	264,144	276,304	291,284	292,384	326,097
Percentage mined by surface ------	43.8	50.0	48.9	49.5	54.0
Mechanically cleaned thousand short tons --	323,452	271,401	292,829	288,918	265,150
Percentage mechanically cleaned ------	53.6	49.1	49.2	48.8	43.9
Number of mines ----------------------	5,601	5,149	4,879	4,744	5,247
Capacity at 235 days thousand short tons --	621,000	618,000	622,000	618,000	653,458
Average number of men working daily: [3]					
Underground mines ---------------	107,808	109,311	112,252	111,083	119,416
Surface mines --------------------	32,332	36,353	37,013	37,038	47,285
Total ----------------------------	140,140	145,664	149,265	148,121	166,701
Average number of days worked:					
Underground mines ---------------	229	210	222	231	205
Surface mines --------------------	225	212	217	215	208
Total ----------------------------	228	210	r 221	227	206
Average production per man per day: [3]					
Underground mines -- short tons --	13.76	12.03	11.91	11.66	11.31
Surface mines ------------ do ----	36.26	35.88	36.33	36.67	33.16
Total ------------------- do ----	18.84	18.02	17.74	17.58	17.58

r Revised.

[1] Bureau of the Census, U.S. Department of Commerce.

[2] Interstate Commerce Commission.

[3] Estimates based on data supplied by Health and Safety Analysis Center, Mining Enforcement and Safety Administration.

Table 2.—Demonstrated coal reserve base of the United States on January 1, 1974, by underground method of mining

(Million tons)

State	Sulfur range, percent				
	<1.0	1.1–3.0	>3.0	Unknown	Total[1]
Alabama	589.3	1,016.7	14.8	176.2	1,798.1
Alaska	4,080.8	163.2	--	--	4,246.4
Arkansas	43.3	310.3	29.2	19.1	402.4
Colorado	6,751.3	640.0	47.3	6,547.3	13,999.2
Georgia	.3	--	--	.2	.5
Illinois	1,034.7	5,848.4	33,647.6	12,908.4	53,441.9
Indiana	443.5	2,746.6	4,355.1	1,402.5	8,948.5
Iowa	1.5	226.7	2,105.9	549.2	2,884.9
Kentucky, East	5,042.7	2,391.9	212.7	1,814.0	9,466.5
Kentucky, West	--	386.6	7,226.4	1,107.1	8,719.9
Maryland	106.5	623.9	171.2	--	901.9
Michigan	4.6	84.9	20.8	7.0	117.6
Missouri	--	184.2	3,590.2	2,350.5	6,078.6
Montana	63,464.2	1,939.8	456.2	--	65,834.3
New Mexico	1,894.3	214.1	.9	27.5	2,136.5
North Carolina	--	--	--	31.3	31.3
Ohio	115.5	5,449.9	10,109.4	1,754.1	17,428.3
Oklahoma	154.5	238.5	202.6	264.3	860.1
Oregon	1.0	--	--	--	1.0
Pennsylvania	7,179.7	16,195.2	3,568.1	2,864.8	29,819.2
Tennessee	139.3	370.0	101.4	53.9	667.1
Utah	1,916.2	1,397.6	6.8	460.3	3,780.5
Virginia	1,728.5	945.4	12.0	283.3	2,970.7
Washington	431.0	957.8	13.2	42.9	1,445.9
West Virginia	11,086.6	12,583.4	6,552.9	4,142.9	34,377.8
Wyoming	20,719.5	4,535.1	1,275.6	2,955.0	29,490.8
Total[1]	126,928.8	59,400.2	73,720.2	39,761.6	299,839.7

[1] Data may not add to totals shown because of independent rounding.

Table 3.—Demonstrated coal reserve base of the United States on January 1, 1974, by surface method of mining

(Million tons)

State	Sulfur range, percent				
	<1.0	1.1–3.0	>3.0	Unknown	Total[1]
Alabama	35.4	83.2	1.6	1,063.2	1,183.7
Alaska	7,377.6	21.0	--	--	7,399.0
Arizona	173.3	176.7	--	--	350.0
Arkansas	37.9	152.8	17.1	55.2	263.3
Colorado	724.2	146.2	--	--	870.0
Illinois	60.4	1,493.0	9,321.3	1,347.8	12,222.9
Indiana	105.3	559.2	907.3	101.6	1,674.1
Kansas		309.2	695.6	383.2	1,388.1
Kentucky, East	1,515.7	929.9	86.8	915.8	3,450.2
Kentucky, West	.2	177.8	2,017.5	1,708.8	3,904.0
Maryland	28.6	66.6	16.2	34.6	146.3
Michigan	--	.5	.1	--	.6
Missouri	--	47.8	1,635.8	1,730.0	3,413.7
Montana	38,182.4	2,175.2	46.4	2,166.7	42,561.9
New Mexico	1,681.0	579.3	--	--	2,258.3
North Carolina	--	--	--	.4	.4
North Dakota	5,389.0	10,325.4	268.7	15.0	16,003.0
Ohio	18.9	991.0	2,524.9	117.9	3,653.9
Oklahoma	120.5	88.1	38.8	186.2	434.1
Oregon	.5	.3	--	--	.8
Pennsylvania	138.6	718.4	231.5	89.5	1,181.4
South Dakota	103.1	287.9	35.9	1.0	428.0
Tennessee	65.5	163.2	55.2	34.1	319.6
Texas	659.3	1,884.6	284.1	444.0	3,271.9
Utah	52.3	149.1	42.6	18.0	262.0
Virginia	411.6	218.1	2.1	46.7	679.2
Washington	172.5	307.7	25.8	2.2	508.1
West Virginia	3,005.5	1,422.8	270.4	509.6	5,212.0
Wyoming	13,192.8	10,122.3	425.5	105.3	23,845.3
Total[1]	73,252.3	33,597.4	18,950.9	11,076.1	136,885.7

[1] Data may not add to totals shown because of independent rounding.

Table 4.—Demonstrated coal reserve base of the United States on January 1, 1974, total underground and surface

(Million tons)

State	Sulfur range, percent				
	<1.0	1.1–3.0	>3.0	Unknown	Total[1]
Alabama	624.7	1,099.9	16.4	1,239.4	2,981.8
Alaska	11,458.4	184.2	--	--	11,645.4
Arizona	173.3	176.7	--	--	350.0
Arkansas	81.2	463.1	46.3	74.3	665.7
Colorado	7,475.5	786.2	47.3	6,547.3	14,869.2
Georgia	.3	--	--	.2	.5
Illinois	1,095.1	7,341.4	42,968.9	14,256.2	65,664.8
Indiana	548.8	3,305.8	5,262.4	1,504.1	10,622.6
Iowa	1.5	226.7	2,105.9	549.2	2,884.9
Kansas	--	309.2	695.6	383.2	1,388.1
Kentucky, East	6,558.4	3,321.8	299.5	2,729.3	12,916.7
Kentucky, West	.2	564.4	9,243.9	2,815.9	12,623.9
Maryland	135.1	690.5	187.4	34.6	1,048.2
Michigan	4.6	85.4	20.9	7.0	118.2
Missouri	--	182.0	5,226.0	4,080.5	9,487.3
Montana	101,646.6	4,115.0	502.6	2,166.7	108,396.2
New Mexico	3,575.3	793.4	.9	27.5	4,394.8
North Carolina	--	--	--	31.7	31.7
North Dakota	5,389.0	10,325.4	268.7	15.0	16,003.0
Ohio	134.4	6,440.9	12,634.3	1,872.0	21,077.2
Oklahoma	275.0	326.6	241.4	450.5	1,294.2
Oregon	1.5	.3	--	--	1.8
Pennsylvania	7,318.3	16,913.6	3,799.6	2,954.2	31,000.6
South Dakota	103.1	287.9	35.9	1.0	428.0
Tennessee	204.8	538.2	156.6	88.0	986.7
Texas	659.8	1,884.6	284.1	444.0	3,271.9
Utah	1,968.5	1,546.7	49.4	478.3	4,042.5
Virginia	2,140.1	1,163.5	14.1	330.0	3,649.9
Washington	603.5	1,265.5	39.0	45.1	1,954.0
West Virginia	14,092.1	14,006.2	6,823.3	4,652.5	39,589.8
Wyoming	33,912.3	14,657.4	1,701.1	3,060.3	53,336.1
Total[1]	200,181.1	92,997.6	92,671.1	50,837.7	436,725.4

[1] Data may not add to totals shown because of independent rounding.

Table 5.—Annual average unit heat value of bituminous coal and lignite produced and consumed in the United States, 1955–74[1]

Year	Total production			Domestic consumption		
	Thousand short tons	Trillion Btu	Average Btu per pound	Thousand short tons	Trillion Btu	Average Btu per pound
1955	464,633	12,080	13,000	423,412	10,940	12,290
1956	500,874	13,013	12,990	432,858	11,142	12,870
1957	492,704	12,800	12,990	413,668	10,640	12,860
1958	410,446	10,663	12,990	366,703	9,366	12,770
1959	412,028	10,581	12,840	366,256	9,332	12,740
1960	415,512	10,662	12,830	380,429	9,693	12,740
1961	402,977	10,308	12,790	374,405	9,502	12,690
1962	422,149	10,782	12,790	387,774	9,826	12,670
1963	458,928	11,712	12,760	409,225	10,358	12,650
1964	486,998	12,418	12,750	431,116	10,899	12,640
1965	512,088	13,017	12,710	459,164	11,580	12,610
1966	533,881	13,507	12,650	486,266	12,205	12,550
1967	552,626	13,904	12,580	480,416	11,981	12,470
1968	545,245	13,664	12,530	498,830	12,401	12,430
1969	560,505	13,957	12,450	507,275	12,509	12,330
1970	602,932	14,820	12,290	515,619	12,488	12,110
1971	552,192	13,385	12,120	494,862	11,857	11,980
1972	595,386	14,319	12,025	516,776	12,273	11,875
1973	591,738	14,208	12,005	556,022	13,150	11,825
1974	603,406	14,320	11,865	552,709	12,750	11,535

[1] Prior to 1973 the average heat content of the annual output of bituminous coal and lignite was measured at 13,100 Btu per pound. This value was based on an estimate made in 1949 (Bureau of Mines Information Circular 7538). In recent years this heat value has not been representative of the average unit heat value of the total annual coal supply because of the large annual increases in utilization of coal of lower heat values by the electric utility industry. The annual production values shown in this table are weighted averages of known and estimated Btu values of coal shipments to each major consuming sector. They include, for example, the Btu value of coal consumed at electric utility generating plants as reported to the Federal Power Commission and compiled by the National Coal Association. Currently, electric utility plants account for 70% of total domestic coal consumption. The averages for U.S. consumption exclude shipments overseas and to Canada, the preponderance of which comprises high-Btu-value metallurgical coal, thus accounting for the difference in values between total production and domestic consumption.

Table 6.—Estimated production of bituminous coal and lignite in the United States by week, 1973 and 1974

(Thousand short tons)

1973				1974			
Week ended—	Production	Maximum number of working days	Average production per working day	Week ended—	Production	Maximum number of working days	Average production per working day
Jan. 6	[1]9,307	[1]5	[2]1,861	Jan. 5	[1]8,233	[1]4	[2]2,058
Jan. 13	10,503	6	1,751	Jan. 12	11,185	6	1,864
Jan. 20	11,346	6	1,891	Jan. 19	12,079	6	2,013
Jan. 27	11,556	6	1,926	Jan. 26	12,409	6	2,068
Feb. 3	11,787	6	1,965	Feb. 2	12,900	6	2,150
Feb. 10	10,974	6	1,829	Feb. 9	12,086	6	2,014
Feb. 17	11,349	6	1,892	Feb. 16	12,676	6	2,113
Feb. 24	11,510	6	1,918	Feb. 23	13,274	6	2,212
Mar. 3	12,101	6	2,017	Mar. 2	11,827	6	1,971
Mar. 10	11,585	6	1,931	Mar. 9	11,365	6	1,894
Mar. 17	10,901	6	1,817	Mar. 16	11,320	6	1,887
Mar. 24	10,906	6	1,818	Mar. 23	12,666	6	2,111
Mar. 31	11,994	6	1,999	Mar. 30	13,023	6	2,171
Apr. 7	10,276	5	2,055	Apr. 6	11,303	5	2,261
Apr. 14	11,360	6	1,893	Apr. 13	12,222	6	2,037
Apr. 21	11,325	6	1,888	Apr. 20	13,020	6	2,170
Apr. 28	11,805	6	1,968	Apr. 27	12,885	6	2,148
May 5	11,345	6	1,891	May 4	12,846	6	2,141
May 12	11,229	6	1,872	May 11	13,064	6	2,177
May 19	11,595	6	1,933	May 18	13,019	6	2,170
May 26	11,527	6	1,921	May 25	12,868	6	2,145
June 2	10,672	5	2,134	June 1	11,479	5	2,296
June 9	12,090	6	2,015	June 8	12,842	6	2,140
June 16	12,781	6	2,130	June 15	13,166	6	2,194
June 23	12,650	6	2,108	June 22	13,150	6	2,192
June 30	6,377	3.1	2,057	June 29	8,265	3.7	2,234
July 7	4,626	2.3	2,011	July 6	6,202	2.9	2,139
July 14	10,664	5.2	2,051	July 13	11,829	6	1,972
July 21	11,938	6	1,990	July 20	12,161	6	2,027
July 28	12,025	6	2,004	July 27	12,185	6	2,031
Aug. 4	11,917	6	1,986	Aug. 3	12,340	6	2,057
Aug. 11	12,415	6	2,069	Aug. 10	12,221	6	2,037
Aug. 18	12,042	6	2,007	Aug. 17	13,972	6	2,329
Aug. 25	12,350	6	2,058	Aug. 24	7,569	3.6	2,103
Sept. 1	12,327	6	2,055	Aug. 31	12,721	6	2,120
Sept. 8	10,147	5	2,029	Sept. 7	11,020	5	2,204
Sept. 15	12,196	6	2,033	Sept. 14	12,493	6	2,082
Sept. 22	12,582	6	2,097	Sept. 21	13,144	6	2,191
Sept. 29	12,784	6	2,131	Sept. 28	13,583	6	2,264
Oct. 6	11,862	6	1,977	Oct. 5	12,893	6	2,149
Oct. 13	11,959	6	1,993	Oct. 12	13,382	6	2,230
Oct. 20	11,911	5	2,382	Oct. 19	13,014	6	2,169
Oct. 27	11,989	6	1,998	Oct. 26	13,617	6	2,270
Nov. 3	11,745	6	1,958	Nov. 2	13,236	6	2,206
Nov. 10	12,048	6	2,008	Nov. 9	14,264	6	2,377
Nov. 17	11,502	6	1,917	Nov. 16	7,306	3.2	2,283
Nov. 24	10,298	5	2,060	Nov. 23	4,758	2.1	2,266
Dec. 1	11,524	6	1,921	Nov. 30	4,173	1.8	2,318
Dec. 8	13,149	6	2,192	Dec. 7	5,478	2.4	2,283
Dec. 15	13,082	6	2,180	Dec. 14	10,870	4.6	2,254
Dec. 22	11,653	6	1,942	Dec. 21	10,811	4.8	2,252
Dec. 29	8,229	5	1,646	Dec. 28	9,231	4.1	2,251
Jan. 5	[1]1,923	[1]1	[2]1,923	Jan. 4	[1]4,261	[1]2	[2]2,131
Total or average[3]	591,738	298.6	1,982	Total or average[3]	603,406	282.2	2,138

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[1] Figures represent production and number of working days in that part of week included in calendar year shown.

[2] Average daily output for the working days in the calendar year shown.

[3] Data may not add to totals shown because of independent rounding.

Table 7.—Estimated production of bituminous coal and lignite in the United States, by State and by month, 1974[1]

(Thousand short tons)

State	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
Alabama	1,607	1,509	1,544	1,689	1,703	1,589	1,757	1,811	2,035	2,046	1,285	1,249	19,824
Alaska	58	58	59	59	59	59	58	59	59	59	58	55	700
Arizona	460	345	345	464	467	561	539	650	539	692	694	692	6,448
Arkansas	51	34	40	45	52	39	34	32	40	48	13	27	455
Colorado	567	680	593	549	637	516	513	529	604	606	519	583	6,896
Illinois	5,305	5,191	5,532	5,494	5,790	4,699	4,937	4,739	5,345	6,260	1,844	3,079	58,215
Indiana	2,019	1,995	1,939	1,892	2,061	1,949	1,835	2,012	2,042	2,209	1,783	1,990	28,726
Iowa	52	53	60	65	63	52	42	56	51	46	20	30	590
Kansas	63	68	66	73	70	52	51	51	65	66	34	59	718
Kentucky													
Eastern	7,308	7,132	7,182	7,789	8,166	6,803	6,898	7,473	7,054	8,093	5,525	5,933	85,356
Western	4,439	4,332	4,362	4,731	4,958	4,132	4,190	4,540	4,284	4,915	3,355	3,603	51,841
Total	11,747	11,464	11,544	12,520	13,124	10,935	11,088	12,013	11,338	13,008	8,880	9,536	137,197
Maryland	183	185	185	182	174	176	194	224	222	251	179	182	2,337
Missouri	404	412	424	460	460	376	340	380	406	388	288	290	4,623
Montana:													
Bituminous	1,162	1,098	1,168	1,167	1,130	1,120	1,171	1,113	1,092	1,219	1,170	1,165	13,775
Lignite	28	26	28	28	27	27	29	27	26	29	28	28	331
Total	1,190	1,124	1,196	1,195	1,157	1,147	1,200	1,140	1,118	1,248	1,198	1,193	14,106
New Mexico	884	724	803	797	825	710	722	867	793	894	628	745	9,392
North Dakota	650	661	633	632	622	565	570	649	602	655	611	613	7,463
Ohio	4,233	3,935	4,042	4,116	4,488	3,687	3,982	3,558	3,953	4,297	2,168	2,955	45,409
Oklahoma	202	160	144	134	205	169	228	233	220	241	205	215	2,356
Pennsylvania	7,355	6,685	7,700	7,246	7,824	6,258	6,520	6,882	7,506	8,831	3,420	4,235	80,462
Tennessee	730	533	574	755	769	623	558	717	613	753	454	462	7,541
Texas	644	662	652	620	639	628	640	618	598	657	659	667	7,684
Utah	415	465	461	455	451	411	494	539	516	606	550	495	5,858
Virginia	3,038	2,671	2,835	3,088	3,181	2,700	2,561	3,151	3,065	3,095	2,209	2,732	34,326
Washington	322	311	310	316	319	322	322	328	333	339	347	344	3,913
West Virginia	9,922	8,524	7,972	9,788	10,720	8,286	8,770	8,944	8,736	11,302	3,783	5,715	102,462
Wyoming	1,611	1,604	1,625	1,767	1,802	1,556	1,436	1,626	1,887	1,898	1,883	2,008	20,703
Total[2]	53,712	50,053	51,278	54,402	57,662	48,065	49,392	51,808	52,686	60,495	33,702	40,151	603,406

[1] Figures are based principally upon railroad carloadings and river shipments supplemented by direct reports from certain local sources. These estimates include both coal shipped by truck and coal used at the mines, and the totals represent output for all mines producing 1,000 tons or more per year.

[2] Data may not add to totals shown because of independent rounding.

Table 8.—Production of bituminous coal and lignite in the United States, in 1974, by State and type of mining

(Thousand short tons)

State	Underground	Strip	Auger	Strip-auger	Total[1]
Alabama	7,053	11,656	--	1,115	19,824
Alaska	--	700	--	--	700
Arizona	--	6,448	--	--	6,448
Arkansas	--	455	--	--	455
Colorado	3,260	3,636	--	--	6,896
Illinois	31,256	26,960	--	--	58,215
Indiana	139	23,587	--	--	23,726
Iowa	379	211	--	--	590
Kansas	--	718	--	--	718
Kentucky:					
Eastern	40,509	16,503	1,546	26,798	85,356
Western	22,988	28,853	--	--	51,841
Total	63,497	45,356	1,546	26,798	137,197
Maryland	90	2,017	--	230	2,337
Missouri		4 628	--	--	4,628
Montana:					
Bituminous	--	13,775	--	--	13,775
Lignite	--	331	--	--	331
Total	--	14,106	--	--	14,106
New Mexico	529	8,864	--	--	9,392
North Dakota (lignite)	--	7,463	--	--	7,463
Ohio	14,365	20,852	265	9,928	45,409
Oklahoma	--	2,191	--	165	2,356
Pennsylvania	42,249	36,332	281	1,600	80,462
Tennessee	3,106	3,475	29	931	7,541
Texas (lignite)	--	7,684	--	--	7,684
Utah	5,858	--	--	--	5,858
Virginia	22,767	7,874	767	2,918	34,326
Washington	15	3,898	--	--	3,913
West Virginia	82,220	15,758	415	4,070	102,462
Wyoming	526	20,176	--	--	20,703
Total[1]	277,309	275,041	3,302	47,755	603,406

[1] Data may not add to totals shown because of independent rounding.

Table 9.—Production of bituminous coal and lignite in the United States in 1974, by district and type of mining

(Thousand short tons)

District	Underground	Strip	Auger	Strip-auger	Total[1]
1. Eastern Pennsylvania	19,830	30,025	171	1,812	51,838
2. Western Pennsylvania	23,851	9,137	111	148	33,241
3. Northern West Virginia	22,764	8,035	139	2,220	33,158
4. Ohio	14,365	20,862	265	9,928	45,409
5. Michigan	--	--	--	--	--
6. Panhandle	7,118	98	--	--	7,216
7. Southern Number 1	21,302	2,558	319	109	24,288
8. Southern Number 2	95,376	31,834	2,298	32,264	161,772
9. West Kentucky	22,988	28,853	--	--	51,841
10. Illinois	31,256	26,960	--	--	58,215
11. Indiana	139	23,587	--	--	23,726
12. Iowa	379	211	--	--	590
13. Southeastern	7,753	11,933	--	1,115	20,801
14. Arkansas-Oklahoma	--	693	--	165	858
15. Southwestern	--	14,978	--	--	14,978
16. Northern Colorado	300	8	--	--	308
17. Southern Colorado	3,488	3,991	--	--	7,479
18. New Mexico	--	14,949	--	--	14.949
19. Wyoming	526	20,176	--	--	20,703
20. Utah	5,858	.	--	--	5.858
21. North-South Dakota	--	7,463	--	--	7,463
22. Montana	--	14,106	--	--	14,106
23. Washington	15	4,598	--	--	4,613
Total[1]	277,309	275,041	3,302	47,755	603,406

[1] Data may not add to totals shown because of independent rounding.

Table 10.—Number of mines, production, value, men working daily, days active, and output per man per hour and per day at bituminous coal and lignite mines in the United States, in 1974, by State

State	Number of active mines	Production (thousand short tons)					Average value per ton[4]	Average number of men working daily	Average number of days worked	Average tons per man per hour	Average tons per man per day
		Shipped by rail or water[1]	Shipped by truck	Mine-mouth generating plants	All other[2]	Total[3]					
Alabama	136	14,168	3,686	1,970	--	19,824	$21.79	6,491	214	1.59	14.49
Alaska	1	565	135	--	--	700	W	80	267	3.67	33.36
Arizona	2	2,515	--	--	3,933	6,448	W	248	255	10.89	78.95
Arkansas	7	438	17	--	--	455	21.28	142	250	1.46	11.34
Colorado	31	5,912	414	555	14	6,896	9.38	1,796	239	2.32	19.56
Illinois	55	47,779	3,433	6,560	445	58,215	10.00	11,867	229	2.57	20.08
Indiana	41	18,889	4,532	299	7	23,726	8.36	2,537	245	4.30	32.02
Iowa	8	150	440	--	--	590	7.79	94	270	2.35	20.46
Kansas	7	380	70	266	1	718	7.61	161	196	1.83	13.51
Kentucky:											
Eastern	1,684	80,548	4,601	138	69	85,356	22.01	27,824	172	2.16	16.84
Western	105	43,565	1,563	6,713	--	51,841	8.92	9,221	228	2.98	24.14
Total	1,789	124,113	6,164	6,851	69	137,197	17.06	37,045	186	2.44	19.26
Maryland	62	1,619	718	--	--	2,337	20.81	405	224	3.32	24.54
Missouri	10	1,633	25	2,965	(5)	4,623	6.36	709	209	2.75	20.02
Montana:											
Bituminous	6	13,755	20	--	--	13,775	3.91	377	265	16.74	134.42
Lignite	2	329	2	--	--	331	W	20	248	7.41	59.28
Total	8	14,084	22	--	--	14,106	3.90	397	264	16.31	130.94
New Mexico	6	1,516	2	7,873	1	9,392	W	833	247	5.68	46.66
North Dakota (lignite)	13	3,579	126	3,746	12	7,463	2.19	373	238	8.17	66.88
Ohio	257	27,037	13,038	5,285	50	45,409	12.32	10,771	218	2.24	17.01
Oklahoma	14	2,122	227	--	7	2,356	10.51	515	226	2.33	17.66
Pennsylvania	1,061	51,521	22,026	6,479	436	80,462	20.35	26,341	224	1.66	13.68
Tennessee	125	5,260	2,267	(5)	14	7,541	18.02	2,218	221	1.79	15.90
Texas (lignite)	4	--	258	7,426	--	7,684	W	293	329	10.00	80.50
Utah	15	3,923	1,209	714	11	5,858	12.24	1,514	220	1.87	15.32
Virginia	682	30,426	3,876	--	28	34,326	24.94	13,033	204	1.47	11.88
Washington	3	--	23	3,890	--	3,913	W	385	238	4.26	44.31
West Virginia	891	92,767	3,635	5,695	364	102,462	21.65	47,213	194	1.35	10.79
Wyoming	19	14,518	39	6,061	84	20,703	5.02	1,240	260	8.24	65.93
Total[3]	5,247	464,915	66,382	66,635	5,474	603,406	15.75	166,701	206	2.21	17.58

W Withheld to avoid disclosing individual company confidential data.

[1] Includes coal loaded at mines directly into railroad cars or river barges, hauled by trucks to railroad siding, and hauled by trucks to waterways.

[2] Includes coal used at mine for power and heat, made into beehive coke at mine, used by mine employees, used for other purposes at mine, and shipped by slurry pipeline in Arizona.

[3] Data may not add to totals shown because of independent rounding.

[4] Value received or charged for coal, f.o.b. mine. Includes a value, estimated by producer, for coal not sold.

[5] Less than 500 tons.

Table 11.—Number of mines, production, value, men working daily, days active, and output per man per hour and per day at bituminous coal and lignite mines in the United States, in 1974, by district

District	Number of active mines	Production (thousand short tons) Shipped by rail or water[1]	Shipped by truck	Mine-mouth generating plants	All other[2]	Total[3]	Average value per ton[4]	Average number of men working daily	Average number of days worked	Average tons per man per hour	Average tons per man per day
1. Eastern Pennsylvania	810	29,317	15,613	6,507	401	51,838	$18.84	15,204	220	1.80	15.06
2. Western Pennsylvania	338	25,837	7,322	46	35	33,241	22.51	12,323	229	1.51	12.27
3. Northern West Virginia	246	29,069	1,582	2,454	54	33,158	16.22	10,499	197	1.87	15.03
4. Ohio	257	27,037	13,038	5,285	50	45,409	12.32	10,771	218	2.24	17.01
5. Michigan	--	--	--	--	--	--	--	--	--	--	--
6. Panhandle	11	3,954	234	3,022	6	7,216	12.28	3,198	208	1.35	10.02
7. Southern Number 1	343	22,862	1,238	--	184	24,283	28.72	14,616	197	.91	7.43
8. Southern Number 2	2,734	150,370	10,842	284	277	161,772	22.93	60,712	185	1.72	13.70
9. West Kentucky	105	43,565	1,563	6,713	--	51,841	8.92	9,221	228	2.98	24.14
10. Illinois	55	47,779	3,433	6,560	445	58,215	10.00	11,867	229	2.57	20.03
11. Indiana	41	18,889	4,532	299	7	23,726	8.36	2,537	245	4.30	32.02
12. Iowa	8	150	440	--	--	590	7.79	94	270	2.35	20.46
13. Southeastern	159	14,901	3,930	1,970	--	20,801	21.58	6,973	213	1.56	12.42
14. Arkansas-Oklahoma	13	837	19	--	3	858	20.39	290	235	1.43	11.57
15. Southwestern	29	3,736	578	10,657	6	14,978	4.63	1,530	235	4.66	34.90
16. Northern Colorado	3	116	93	97	1	308	6.49	148	134	1.64	13.33
17. Southern Colorado	30	6,687	321	458	12	7,479	10.15	1,990	246	2.15	18.13
18. New Mexico	6	3,140	2	7,873	3,935	14,949	3.15	739	258	9.31	71.73
19. Wyoming	19	14,518	39	6,061	84	20,703	5.02	1,240	260	8.24	65.93
20. Utah	15	3,923	1,209	714	11	5,858	12.24	1,514	220	1.87	15.32
21. North-South Dakota	13	3,579	126	3,746	12	7,463	2.19	373	238	8.17	66.83
22. Montana	8	14,084	22	--	--	14,106	3.90	397	264	16.31	130.94
23. Washington	4	565	158	3,890	--	4,613	6.42	465	243	4.17	42.28
Total	5,247	464,915	66,382	66,635	5,474	603,406	15.75	166,701	206	2.21	17.58

[1] Includes coal loaded at mines directly into railroad cars or river barges, hauled by trucks to railroad siding, and hauled by trucks to waterways.

[2] Includes coal used at mine for power and heat, made into beehive coke at mine, used by mine employees, used for other purposes at mine, and shipped by slurry pipeline in Arizona.

[3] Data may not add to totals shown because of independent rounding.

[4] Value received or charged for coal, f.o.b. mine. Includes a value, estimated by producer, for coal not sold.

Table 12.—Average value per ton, f.o.b. mines, of bituminous coal and lignite produced in the United States, by State

State	1973					1974				
	Underground	Strip	Auger	Strip-auger [1]	Total	Underground	Strip	Auger	Strip-auger [1]	Total
Alabama	$15.54	$8.04	$6.69	--	$11.01	$30.30	$17.84	--	--	$21.79
Alaska	--	W	--	--	W	--	W	--	--	W
Arizona	--	W	--	--	W	--	W	--	--	W
Arkansas	13.89	13.36	--	--	13.37	--	21.28	--	--	21.28
Colorado	9.95	4.43	5.51	--	7.41	13.89	5.33	--	--	9.38
Illinois	7.52	5.81	--	--	6.71	11.12	8.70	--	--	10.00
Indiana	6.94	6.04	--	--	6.06	W	8.36	--	--	8.36
Iowa	5.40	5.54	--	--	5.46	W	9.15	--	--	7.79
Kansas	--	7.35	--	--	7.35	--	7.61	--	--	7.61
Kentucky:										
Eastern	10.63	7.05	7.22	--	9.03	24.72	15.01	$16.91	$22.52	22.01
Western	6.49	5.58	--	--	5.93	10.25	7.86	--	--	8.92
Total	9.16	6.18	7.22	--	7.73	19.48	10.46	16.91	22.52	17.06
Maryland	7.00	7.65	7.78	--	7.63	W	20.58	--	22.64	20.81
Missouri	--	5.37		--	5.37	--	6.36	--	--	6.36
Montana:										
Bituminous	16.81	2.82	--	--	2.83	--	3.91	--	--	3.91
Lignite	--	2.60	--	--	2.60	--	W	--	--	W
Total	16.81	2.82	--	--	2.82	--	3.90	--	--	3.90
New Mexico	10.00	2.94	--	--	3.51	W	W	--	--	W
North Dakota (lignite)	--	2.07	--	--	2.07	--	2.19	--	--	2.19
Ohio	8.50	6.82	6.20	--	7.40	13.70	12.42	9.95	10.18	12.32
Oklahoma	--	7.69	--	--	7.69	--	9.84	--	• 19.40	10.51
Pennsylvania	12.02	7.68	6.91	--	10.30	22.68	18.01	15.30	14.21	20.35
Tennessee	8.61	7.69	8.52	--	8.13	13.70	22.05	11.69	17.58	18.02
Texas (lignite)	--	W	--	--	W	--	W	--	--	W
Utah	11.19	--	--	--	11.19	12.24	--	--	--	12.24
Virginia	12.70	7.66	7.33	--	11.12	25.87	25.35	17.85	18.46	24.94
Washington	17.74	6.50	--	--	6.56	28.70	W	--	--	W
West Virginia	12.24	8.58	8.66	--	11.61	21.76	22.46	21.74	16.34	21.65
Wyoming	7.07	4.01	--	--	4.09	10.19	4.88	--	--	5.02
Total	10.84	6.11	7.39	--	8.53	19.86	11.11	16.99	18.49	15.75

• Estimate. W Withheld to avoid disclosing individual company confidential data.

[1] For 1973, all tonnages reported as combined strip-auger were mathematically divided into strip production and auger production. In 1974, these combined tonnages were tabulated as reported.

Table 13.—Average value per ton, f.o.b. mines, of bituminous coal and lignite produced, by district

District	1973 Underground	1973 Strip	1973 Auger	1973 Strip-auger[1]	1973 Total	1974 Underground	1974 Strip	1974 Auger	1974 Strip-auger[1]	1974 Total
1. Eastern Pennsylvania	$11.05	$7.80	$6.74	--	$9.27	$19.72	$18.49	$14.90	$15.28	$18.84
2. Western Pennsylvania	12.53	7.28	7.63	--	11.42	24.61	17.18	15.92	18.40	22.51
3. Northern West Virginia	9.60	7.37	7.85	--	9.03	15.75	18.41	13.48	13.28	16.22
4. Ohio	8.50	6.82	6.20	--	7.40	13.70	12.42	9.95	10.18	12.32
5. Michigan	--	--	--	--	--	--	--	--	--	--
6. Panhandle	8.88	7.57	7.57	--	8.86	12.20	14.84	22.24	--	12.28
7. Southern Number 1	16.12	12.77	11.01	--	15.73	28.88	28.44	17.50	24.91	28.72
8. Southern Number 2	11.56	7.41	7.35	--	10.08	24.44	19.88	--	21.87	22.93
9. West Kentucky	6.49	5.53	--	--	5.93	10.25	7.86	--	--	8.92
10. Illinois	7.52	5.81	--	--	6.71	11.12	8.70	--	--	10.00
11. Indiana	6.94	6.04	--	--	6.06	W	8.36	--	--	8.36
12. Iowa	5.40	5.54	--	--	5.46	W	9.15	--	--	7.79
13. Southeastern	15.07	8.02	6.75	--	10.88	28.89	17.98	--	W	21.58
14. Arkansas-Oklahoma	13.89	13.61	--	--	13.61	--	20.63	--	• 19.40	20.39
15. Southwestern	--	4.41	--	--	4.41	--	4.68	--	--	4.68
16. Northern Colorado	W	--	--	--	W	W	W	--	--	6.49
17. Southern Colorado	10.54	4.78	5.51	--	7.89	14.68	6.19	--	--	10.15
18. New Mexico		2.83	--	--	2.83	--	3.15	--	--	3.15
19. Wyoming	7.07	4.01	--	--	4.09	10.19	4.88	--	--	5.02
20. Utah	11.19	--	--	--	11.19	12.24	--	--	--	12.24
21. North-South Dakota	--	2.07	--	--	2.07	--	2.19	--	--	2.19
22. Montana	16.81	2.82	--	--	2.82	--	3.90	--	--	3.90
23. Washington	17.74	7.08	--	--	7.08	23.70	6.34	--	--	6.42
Total	10.84	6.11	7.39	--	8.53	19.86	11.11	16.99	13.49	15.75

• Estimate. W Withheld to avoid disclosing individual company confidential data.

[1] For 1973 all tonnages reported as combined strip-auger were mathematically divided into strip production and auger production. In 1974, these combined tonnages were tabulated as reported.

Table 14.—Production and average value per ton, f.o.b. mines, of bituminous coal and lignite sold in open market and not sold in open market, in 1974, by State

(Thousand short tons)

State	Production: Sold in open market	Production: Not sold in open market	Production: Total	Average value per ton, f.o.b. mines: Sold in open market	Average value per ton, f.o.b. mines: Not sold in open market	Average value per ton, f.o.b. mines: Total
Alabama	16,224	3,600	19,824	$20.55	$27.41	$21.79
Alaska	700	--	700	W	--	W
Arizona	6,448	--	6,448	W	--	W
Arkansas	363	92	455	18.60	W	21.28
Colorado	5,488	1,409	6,896	6.65	W	9.38
Illinois	55,778	2,437	58,215	9.64	W	10.00
Indiana	23,726	--	23,726	8.36	--	8.36
Iowa	590	--	590	7.79	--	7.79
Kansas	718	--	718	7.61	--	7.61
Kentucky:						
Eastern	77,612	7,744	85,356	21.34	28.75	22.01
Western	51,841	--	51,841	8.92	--	8.92
Total	129,453	7,744	137,197	16.36	28.75	17.06
Maryland	2,337	--	2,337	20.81	--	20.81
Missouri	4,628	--	4,628	6.36	--	6.36
Montana:						
Bituminous	13,775	--	13,775	3.91	--	3.91
Lignite	1	330	331	7.27	W	W
Total	13,776	330	14,106	3.91	W	3.90
New Mexico	8,700	692	9,392	W	W	W
North Dakota (lignite)	5,334	2,129	7,463	2.08	2.58	2.19
Ohio	40,335	5,074	45,409	12.30	12.51	12.32
Oklahoma	2,191	165	2,356	9.84	• 19.40	10.51
Pennsylvania	59,050	21,413	80,462	17.85	27.25	20.35
Tennessee	7,541	--	7,541	18.02	--	18.02
Texas (lignite)	--	7,684	7,684	--	W	W
Utah	3,376	2,483	5,858	10.66	14.39	12.24
Virginia	34,326	--	34,326	24.94	--	24.94
Washington	23	3,890	3,913	22.58	W	W
West Virginia	89,829	12,633	102,462	20.77	27.94	21.65
Wyoming	16,558	4,149	20,708	5.32	3.82	5.02
Total[1]	527,482	75,924	603,406	15.16	19.86	15.75

• Estimate. W Withheld to avoid disclosing individual company confidential data.

[1] Data may not add to totals shown because of independent rounding.

Table 15.—Number of mines, men working daily, days active, and output per man per day and per hour at bituminous coal and lignite mines in the United States, in 1974, by State

State	Number of mines		Average number of men working daily			Average number of days worked		Average tons per man per day			Average tons per man per hour		
	Underground	Surface	Underground	Surface	Total	Underground	Surface	Underground	Surface	Total	Underground	Surface	Total
Alabama	19	117	3,955	2,536	6,491	218	216	8.47	18.65	14.49	1.08	2.37	1.59
Alaska	--	1	--	80	80	--	267	--	33.36	33.36	--	3.67	3.67
Arizona	--	2	--	248	248	--	255	--	78.95	78.95	--	10.89	10.89
Arkansas	--	7	--	142	142	--	250	--	11.34	11.34	--	1.46	1.46
Colorado	23	8	1,550	246	1,796	235	268	13.72	51.51	19.56	1.63	6.14	2.32
Illinois	23	32	8,282	3,585	11,867	224	240	15.76	26.49	20.03	1.98	3.59	2.57
Indiana	2	39	32	2,505	2,537	203	246	17.42	32.11	32.02	2.23	4.31	4.30
Iowa	2	6	55	39	94	296	233	22.42	16.97	20.46	2.48	2.05	2.35
Kansas	--	7	--	161	161	--	196	--	13.51	13.51	--	1.83	1.83
Kentucky:													
Eastern	774	910	16,887	10,937	27,824	181	158	12.06	25.30	16.84	1.48	3.49	2.16
Western	29	76	5,688	3,533	9,221	230	224	15.36	38.75	24.14	1.92	4.68	2.98
Total	803	986	22,575	14,470	37,045	193	174	13.30	35.10	19.26	1.64	3.96	2.44
Maryland	1	61	19	386	405	194	226	• 9.12	25.13	24.54	• 1.14	3.41	3.32
Missouri	--	10	--	709	709	--	209	--	20.02	20.02	--	2.75	2.75
Montana:													
Bituminous	--	6	--	377	377	--	265	--	134.42	134.42	--	16.74	16.74
Lignite	--	2	--	20	20	--	248	--	59.28	59.28	--	7.41	7.41
Total	--	8	--	397	397	--	264	--	130.94	130.94	--	16.31	16.31
New Mexico	1	5	300	533	833	229	257	8.27	65.92	46.66	0.97	8.19	5.68
North Dakota (lignite)	--	13	--	373	373		238	--	66.83	66.88	--	8.17	8.17
Ohio	28	229	6,781	3,990	10,771	210	231	10.00	27.90	17.01	1.30	3.75	2.24
Oklahoma	--	14	--	515	515		226		17.66	17.66	--	2.33	2.33
Pennsylvania	132	929	19,685	6,656	26,341	222	231	9.71	24.91	13.68	1.19	2.93	1.66
Tennessee	50	75	1,270	948	2,218	216	227	12.37	20.45	15.90	1.41	2.27	1.79
Texas (lignite)	--	4	--	293	293		329		80.50	80.50		10.00	10.00
Utah	15	--	1,514	--	1,514	220		15.32		15.32	1.87	--	1.87
Virginia	350	332	10,799	2,234	13,033	207	187	9.48	24.88	11.88	1.17	3.13	1.47
Washington	1	2	14	371	385	248	238	5.03	45.78	44.31	.67	4.36	4.26
West Virginia	564	307	42,377	4,836	47,213	196	172	9.64	22.47	10.79	1.21	2.76	1.35
Wyoming	5	14	208	1,032	1,240	213	270	5.65	75.38	65.93	.69	9.47	8.24
Total	2,039	3,208	119,416	47,285	166,701	205	208	11.31	33.16	17.58	1.41	4.24	2.21

• Estimate.

Table 16.—Number of mines, men working daily, days active, and output per man per day and per hour at bituminous coal and lignite mines in the United States, in 1974, by district

District	Number of mines		Average number of men working daily			Average number of days worked		Average tons per man per day			Average tons per man per hour		
	Under-ground	Surface	Under-ground	Surface	Total	Under-ground	Surface	Under-ground	Surface	Total	Under-ground	Surface	Total
1. Eastern Pennsylvania	87	723	9,763	5,441	15,204	210	239	9.54	23.69	15.06	1.14	2.84	1.80
2. Western Pennsylvania	50	288	10,537	1,786	12,323	233	205	9.77	29.03	12.27	1.22	3.31	1.51
3. Northern West Virginia	100	146	8,361	2,138	10,499	201	183	12.70	24.88	15.08	1.59	3.02	1.87
4. Ohio	28	229	6,781	3,990	10,771	210	231	10.00	27.90	17.01	1.30	3.75	2.24
5. Michigan	--	--	--	--	--	--	--	--	--	--	--	--	--
6. Panhandle	8	3	3,180	18	3,198	208	241	9.93	• 22.47	10.02	1.34	• 2.76	1.35
7. Southern Number 1	258	85	13,758	858	14,616	197	139	7.06	16.39	7.43	.87	1.93	.91
8. Southern Number 2	1,375	1,359	45,067	15,645	60,712	191	168	10.40	24.47	13.70	1.29	3.22	1.72
9. West Kentucky	29	76	5,688	3,533	9,221	230	224	15.36	38.75	24.14	1.92	4.68	2.98
10. Illinois	23	32	8,282	3,585	11,867	224	240	15.76	26.49	20.03	1.98	3.59	2.57
11. Indiana	2	39	32	2,505	2,537	203	246	17.42	32.11	32.02	2.23	4.31	4.30
12. Iowa	2	6	55	39	94	296	233	22.42	16.97	20.46	2.48	2.05	2.35
13. Southeastern	32	127	4,326	2,647	6,973	218	212	8.66	18.65	12.42	1.08	2.37	1.56
14. Arkansas-Oklahoma	--	13	--	290	290	--	235	--	11.57	11.57	--	1.43	1.43
15. Southwestern	--	29	--	1,530	1,530	--	285	--	34.90	34.90	--	4.66	4.66
16. Northern Colorado	2	1	132	16	148	147	26	• 13.72	19.02	18.83	• 1.63	2.28	1.64
17. Southern Colorado	22	8	1,718	272	1,990	241	276	12.17	51.11	18.13	1.44	6.07	2.15
18. New Mexico	--	6	--	739	739	--	258	--	71.78	71.78	--	9.31	9.31
19. Wyoming	5	14	208	1,032	1,240	213	270	5.65	75.38	65.93	.69	9.47	8.24
20. Utah	15	--	1,514	--	1,514	220	--	15.32	--	15.32	1.87	--	1.87
21. North-South Dakota	--	18	--	373	373	--	288	--	66.83	66.83	--	8.17	8.17
22. Montana	--	8	--	397	397	--	264	--	130.94	130.94	--	16.31	16.31
23. Washington	1	3	14	451	465	248	248	5.03	43.44	42.28	.67	4.25	4.17
Total	2,039	3,208	119,416	47,285	166,701	205	208	11.31	33.16	17.58	1.41	4.24	2.21

• Estimate.

Table 17.—Number and production of bituminous coal and lignite mines, in 1974, by State, size of output, and type of mining

(Thousand short tons)

State	500,000 tons and over		200,000 to 500,000 tons		100,000 to 200,000 tons		50,000 to 100,000 tons		10,000 to 50,000 tons		Less than 10,000 tons		Total[1]	
	Number of mines	Quantity	Number of mines	Quantity	Number of mines	Quantity	Number of mines	Quantity	Number of mines	Quantity	Number of mines	Quantity	Number of mines	Quantity
Alabama:														
Underground	6	5,653	3	1,104	1	115	1	74	4	96	4	11	19	7,053
Strip	3	2,278	17	4,893	13	1,764	22	1,676	35	929	26	116	116	11,656
Strip-auger	1	1,115	--	--	--	--	--	--	--	--	--	--	1	1,115
Total[1]	10	9,046	20	5,997	14	1,879	23	1,750	39	1,025	30	127	136	19,824
Alaska: Strip	1	700	--	--	--	--	--	--	--	--	--	--	1	700
Arizona: Strip	2	6,448	--	--	--	--	--	--	--	--	--	--	2	6,448
Arkansas: Strip	--	--	--	--	3	375	1	51	1	17	2	12	7	455
Colorado:														
Underground	2	1,040	2	959	6	1,017	1	91	5	128	7	25	23	3,260
Strip	3	2,929	1	457	2	220	--	--	2	31	--	--	8	3,636
Total[1]	5	3,969	3	1,415	8	1,237	1	91	7	159	7	25	31	6,896
Illinois:														
Underground	20	31,074	--	--	--	--	2	176	--	--	1	5	23	31,256
Strip	18	25,587	3	810	1	143	5	331	3	81	2	9	32	26,960
Total[1]	38	56,661	3	810	1	143	7	507	3	81	3	14	55	58,215
Indiana:														
Underground	--	--	--	--	--	--	2	139	--	--	--	--	2	139
Strip	13	22,031	2	570	4	470	3	197	11	294	6	26	39	23,587
Total[1]	13	22,031	2	570	4	470	5	336	11	294	6	26	41	23,726
Iowa:														
Underground	--	--	1	262	1	117	--	--	--	--	--	--	2	379
Strip	--	--	--	--	--	--	2	119	4	92	--	--	6	211
Total[1]	--	--	1	262	1	117	2	119	4	92	--	--	8	590
Kansas: Strip	--	--	1	266	3	417	--	--	1	26	2	9	7	718
Kentucky:														
Eastern:														
Underground	13	9,473	31	9,633	51	7,262	76	5,208	326	7,845	277	1,089	774	40,509
Strip	2	2,266	23	6,866	23	3,234	30	2,106	79	1,738	64	293	221	16,503
Auger	--	--	--	--	3	360	5	361	36	690	29	134	73	1,546
Strip-auger	2	1,406	16	4,459	47	6,176	104	7,395	274	6,563	173	799	616	26,798
Total[1]	17	13,145	70	20,958	124	17,032	215	15,071	715	16,836	543	2,314	1,684	85,356

Western:														
Underground	19	21,760	2	794	--	--	4	283	4	151	--	--	29	22,988
Strip	14	23,045	10	3,699	8	1,105	7	502	18	398	19	104	76	28,853
Total¹	33	44,805	12	4,493	8	1,105	11	785	22	549	19	104	105	51,841
Total Kentucky:														
Underground	32	31,233	33	10,427	51	7,262	80	5,491	330	7,996	277	1,089	803	63,497
Strip	16	25,311	33	10,566	31	4,338	37	2,608	97	2,136	83	397	297	45,356
Auger	--	--	--	--	3	360	5	361	36	690	29	134	73	1,546
Strip-auger	2	1,406	16	4,459	47	6,176	104	7,395	274	6,563	173	799	616	26,798
Total¹	50	57,950	82	25,452	132	18,137	226	15,856	737	17,385	562	2,418	1,789	137,197
Maryland:														
Underground	--	--	--	--	--	--	1	90	--	--	--	--	1	90
Strip	--	--	--	--	2	338	11	889	30	731	12	58	55	2,017
Strip-auger	--	--	--	--	--	--	2	144	3	83	1	3	6	230
Total¹	--	--	--	--	2	338	14	1,124	33	814	13	61	62	2,337
Missouri: Strip	5	3,895	1	438	2	279	--	--	--	--	2	11	10	4,623
Montana: Strip	4	13,756	1	330	--	--	--	--	1	11	2	10	8	14,106
New Mexico:														
Underground	1	529	--	--	--	--	--	--	--	--	--	--	1	529
Strip	3	8,382	1	363	1	119	--	--	--	--	--	--	5	8,864
Total¹	4	8,911	1	363	1	119	--	--	--	--	--	--	6	9,392
North Dakota: Strip	5	6,689	2	571	1	159	--	--	3	36	2	7	13	7,463
Ohio:														
Underground	15	13,022	3	995	1	121	2	111	3	94	4	22	28	14,365
Strip	7	4,554	24	7,416	25	3,580	46	3,335	61	1,762	36	204	199	20,852
Auger	--	--	--	--	--	--	1	73	6	149	7	43	14	265
Strip-auger	7	8,624	3	969	1	155	2	119	2	56	1	4	16	9,928
Total¹	29	26,200	30	9,380	27	3,856	51	3,638	72	2,061	48	274	257	45,409
Oklahoma:														
Strip	2	1,541	--	--	2	317	4	262	2	61	3	11	13	2,191
Strip auger	--	--	--	--	1	165	--	--	--	--	--	--	1	165
Total¹	2	1,541	--	--	3	482	4	262	2	61	3	11	14	2,356
Pennsylvania														
Underground	37	29,223	28	9,494	16	2,289	10	636	22	519	19	87	132	42,249
Strip	1	714	17	4,778	25	3,217	198	14,313	469	12,531	153	780	863	36,332
Auger	--	--	--	--	--	--	--	--	13	219	15	62	28	281
Strip-auger	1	514	--	--	--	--	2	133	30	935	5	18	38	1,600
Total¹	39	30,450	45	14,272	41	5,506	210	15,082	534	14,205	192	947	1,061	80,462

See footnote at end of table.

Table 17.—Number and production of bituminous coal and lignite mines, in 1974, by State, size of output, and type of mining—Continued

(Thousand short tons)

State	500,000 tons and over		200,000 to 500,000 tons		100,000 to 200,000 tons		50,000 to 100,000 tons		10,000 to 50,000 tons		Less than 10,000 tons		Total[1]	
	Number of mines	Quantity	Number of mines	Quantity	Number of mines	Quantity	Number of mines	Quantity	Number of mines	Quantity	Number of mines	Quantity	Number of mines	Quantity
Tennessee:														
Underground	1	949	2	626	4	514	5	313	23	634	15	70	50	3,106
Strip	--	--	--	--	13	1,842	9	618	29	954	15	66	66	3,475
Auger	--	--	--	--	--	--	--	--	1	21	2	8	3	29
Strip-auger	--	--	2	640	1	120	3	171	--	--	--	--	6	931
Total[1]	1	949	4	1,266	18	2,476	17	1,097	53	1,609	32	145	125	7,541
Texas: Strip	2	7,137	2	547	--	--	--	--	--	--	--	--	4	7,684
Utah: Underground	2	2,053	9	3,479	1	162	2	153	1	10	--	--	15	5,858
Virginia:														
Underground	6	4,907	24	7,237	21	2,848	35	2,541	213	4,974	51	260	350	22,767
Strip	--	--	1	313	16	2,228	17	1,262	130	3,581	94	491	258	7,874
Auger	--	--	--	--	--	--	1	60	27	667	6	39	34	767
Strip-auger	--	--	1	375	9	1,250	16	984	12	297	2	12	40	2,918
Total[1]	6	4,907	26	7,925	46	6,325	69	4,848	382	9,519	153	802	682	34,326
Washington:														
Underground	--	--	--	--	--	--	--	--	1	15	--	--	1	15
Strip	1	3,890	--	--	--	--	--	--	--	--	1	8	2	3,898
Total[1]	1	3,890	--	--	--	--	--	--	1	15	1	8	3	3,913
West Virginia:														
Underground	40	36,221	77	23,912	84	11,562	86	6,125	163	3,809	134	590	584	82,220
Strip	2	1,408	13	3,925	34	4,486	43	3,123	100	2,630	37	185	229	15,758
Auger	--	--	--	--	1	121	1	90	8	172	6	32	16	415
Strip-auger	--	--	3	780	12	1,673	14	993	22	546	11	77	62	4,070
Total[1]	42	37,630	93	28,618	131	17,843	144	10,331	293	7,157	188	884	891	102,462
Wyoming:														
Underground	--	--	1	370	1	103	--	--	1	47	2	6	5	526
Strip	12	20,155	--	--	--	--	--	--	1	20	1	1	14	20,176
Total[1]	12	20,155	1	370	1	103	--	--	2	67	3	7	19	20,703

United States:																
Underground	162	155,904	183	58,865	187	26,110	227	15,941	766	18,322	514	2,167	2,039	277,309		
Strip	100	157,405	119	86,242	178	24,290	398	28,780	980	25,923	479	2,401	2,254	275,041		
Auger	--	--	--	--	4	482	8	584	91	1,918	65	318	168	3,302		
Strip-auger	11	11,659	25	7,223	71	9,539	143	9,940	348	8,481	193	913	786	47,755		
Total[1]	273	324,969	327	102,331	440	60,421	776	55,245	2,180	54,643	1,251	5,798	5,247	603,406		

[1] Data may not add to totals shown because of independent rounding.

Table 18.—Production, shipments, and value at bituminous coal and lignite mines, in 1974, by State and county

(Thousand short tons)

State and county	Production								Shipments					Average value per ton[4]
	Underground		Strip		Auger		Strip-auger							
	Number of mines	Quantity	Number of mines	Quantity	Number of mines	Quantity	Number of mines	Quantity	Rail or water[1]	Truck	Mine-mouth generating plants	All other[2]	Total[3]	
Alabama:														
Bibb	--	--	2	268	--	--	--	--	263	5	--	--	268	$14.52
Blount	1	15	9	350	--	--	--	--	288	77	--	--	365	21.96
Cherokee	--	--	1	1	--	--	--	--	--	1	--	--	1	17.88
Cullman	--	--	8	696	--	--	--	--	421	275	--	--	696	22.11
De Kalb	--	--	4	94	--	--	--	--	--	94	--	--	94	17.88
Fayette	1	40	5	103	--	--	--	--	120	28	--	--	144	24.34
Jackson	1	2	2	669	--	--	--	--	662	10	--	--	671	W
Jefferson	12	4,394	21	2,576	--	--	1	1,115	6,669	1,149	267	--	8,085	22.41
Marion	1	20	7	285	--	--	--	--	232	74	--	--	305	18.99
Shelby	--	--	2	378	--	--	--	--	378	--	--	--	378	25.13
Tuscaloosa	--	--	9	1,979	--	--	--	--	1,872	107	--	--	1,979	15.52
Walker	8	2,581	34	3,458	--	--	--	--	3,028	1,307	1,703	--	6,039	23.88
Winston	--	--	12	799	--	--	--	--	235	563	--	--	799	18.37
Total[3]	19	7,053	116	11,656	--	--	1	1,115	14,168	3,686	1,970	--	19,824	21.79
Alaska	--	--	1	700	--	--	--	--	565	135	--	--	700	W
Arizona: Navajo	--	--	2	6,448	--	--	--	--	2,515	--	--	3,933	6,448	W
Arkansas:														
Franklin	--	--	1	101	--	--	--	--	101	--	--	--	101	W
Johnson	--	--	2	161	--	--	--	--	161	--	--	--	161	W
Logan	--	--	1	17	--	--	--	--	--	17	--	--	17	W
Sebastian	--	--	3	176	--	--	--	--	176	--	--	--	176	W
Total	--	--	7	455	--	--	--	--	438	17	--	--	455	21.28

See footnotes at end of table.

Table 18.—Production, shipments, and value at bituminous coal and lignite mines, in 1974, by State and county—Continued

(Thousand short tons)

State and county	Production								Shipments					Average value per ton[4]
	Underground		Strip		Auger		Strip-auger							
	Number of mines	Quantity	Number of mines	Quantity	Number of mines	Quantity	Number of mines	Quantity	Rail or water[1]	Truck	Mine-mouth generating plants	All other[2]	Total[3]	
Colorado:														
Delta	3	374	--	--	--	--	--	--	366	1	--	7	374	W
Fremont	2	35	1	113	--	--	--	--	5	143	--	--	148	W
Garfield	1	1	--	--	--	--	--	--	--	1	--	--	1	$14.91
Gunnison	3	891	--	--	--	--	--	--	860	26	--	5	891	16.03
Jackson	--	--	1	8	--	--	--	--	8	--	--	--	8	W
La Plata	1	10	--	--	--	--	--	--	--	10	--	--	10	9.80
Las Animas	1	540	--	--	--	--	--	--	540	--	--	--	540	[5] 20.00
Mesa	1	1	--	--	--	--	--	--	--	--	1	--	1	9.52
Moffat	2	243	--	--	--	--	--	--	238	5	--	--	243	W
Montrose	--	--	1	107	--	--	--	--	--	107	--	--	107	W
Pitkin	5	843	1	23	--	--	--	--	866	--	--	--	866	9.68
Rio Blanco	1	12	--	--	--	--	--	--	--	12	--	--	12	9.80
Routt	1	11	4	3,385	--	--	--	--	2,921	17	457	--	3,396	5.25
Weld	2	300	--	--	--	--	--	--	109	93	97	1	300	W
Total[3]	23	3,260	8	3,636	--	--	--	--	5,912	414	555	14	6,896	9.38
Illinois:														
Christian	1	4,132	--	--	--	--	--	--	995	427	2,706	3	4,132	W
Douglas	2	2,102	--	--	--	--	--	--	1,203	899	--	--	2,102	W
Franklin	3	5,369	--	--	--	--	--	--	5,356	14	--	--	5,369	W
Fulton	--	--	4	2,503	--	--	--	--	2,257	246	--	--	2,503	10.50
Gallatin	2	1,448	1	274	--	--	--	--	1,722	--	--	--	1,722	W
Jackson	--	--	1	66	--	--	--	--	66	--	--	--	66	8.70
Jefferson	3	6,067	1	596	--	--	--	--	6,450	194	--	19	6,663	W
Johnson	--	--	1	5	--	--	--	--	2	3	--	--	5	8.70
Kankakee	--	--	1	143	--	--	--	--	16	127	--	--	143	W
Knox	--	--	1	1,017	--	--	--	--	817	200	--	--	1,017	W
Macoupin	1	2,480	--	--	--	--	--	--	2,480	--	--	--	2,480	W
Mercer	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Montgomery	1	1,640	--	--	--	--	--	--	--	162	1,479	--	1,640	W
Peoria	--	--	3	1,148	--	--	--	--	790	358	--	--	1,148	W
Perry	--	--	5	11,146	--	--	--	--	10,745	10		391	11,146	7.82
Randolph	2	1,572	3	6,505	--	--	--	--	5,611	112	2,355	--	8,078	7.82
St. Clair	1	2,756	1	549	--	--	--	--	3,304	--	--	--	3,304	W
Saline	2	1,238	4	1,192	--	--	--	--	2,161	245	19	5	2,430	W
Stark	--	--	1	258	--	--	--	--	258	--	--	--	253	8.70
Vermilion	1	5	--	--	--	--	--	--	5	--	--	--	5	10.58
Wabash	1	744	--	--	--	--	--	--	698	46	--	--	744	W
Williamson	3	1,702	5	1,562	--	--	--	--	2,847	391	1	25	3,264	12.00
Total[3]	28	31,256	32	26,960	--	--	--	--	47,779	3,433	6,560	445	58,215	10.00

Indiana:														
Clay	--	--	7	1,051	--	--	--	--	--	1,051	--	--	1,051	W
Fountain	--	--	1	56	--	--	--	--	--	55	--	--	56	W
Greene	--	--	3	822	--	--	--	--	805	18	--	--	822	W
Knox	--	--	2	770	--	--	--	--	499	271	--	--	770	W
Owen	--	--	1	30	--	--	--	--	--	30	--	--	30	8.36
Parke	--	--	1	2	--	--	--	--	--	2	--	--	2	W
Pike	1	75	7	5,018	--	--	--	--	3,770	1,015	298	5	5,088	W
Spencer	--	--	5	561	--	--	--	--	463	97	--	--	561	12.35
Sullivan	--	--	3	3,189	--	--	--	--	2,559	630	--	--	3,189	W
Vermillion	--	--	1	2,833	--	--	--	--	2,761	73	--	--	2,833	W
Vigo	1	64	--	--	--	--	--	--	--	64	--	--	64	W
Warrick	--	--	8	9,261	--	--	--	--	8,033	1,227	--	1	9,261	W
Total [3]	2	139	39	23,587	--	--	--	--	18,889	4,532	298	6	23,726	8.36
Iowa:														
Lucas	1	117	--	--	--	--	--	--	--	117	--	--	117	W
Mahaska	--	--	3	108	--	--	--	--	65	43	--	--	108	8.57
Marion	--	--	2	36	--	--	--	--	18	18	--	--	36	W
Monroe	1	262	--	--	--	--	--	--	--	262	--	--	262	6.90
Wapello	--	--	1	67	--	--	--	--	67	--	--	--	67	9.15
Total [3]	2	379	6	211	--	--	--	--	150	440	--	--	590	7.79
Kansas:														
Bourbon	--	--	1	26	--	--	--	--	26	--	--	--	26	W
Cherokee	--	--	2	138	--	--	--	--	134	3	--	1	138	W
Crawford	--	--	2	283	--	--	--	--	217	66	--	--	283	• 8.92
Linn	--	--	1	266	--	--	--	--	--	--	266	--	266	W
Wilson	--	--	1	5	--	--	--	--	4	1	--	--	5	W
Total [3]	--	--	7	718	--	--	--	--	380	70	266	1	718	7.61
Kentucky:														
Eastern:														
Bell	17	915	10	2,214	--	--	21	1,107	4,127	109	--	--	4,236	17.08
Boyd	--	--	2	83	--	--	3	110	148	45	--	--	193	23.74
Breathitt	1	55	21	4,059	1	40	28	1,401	5,547	8	--	--	5,555	13.30
Carter	1	2	13	297	--	--	11	253	514	38	--	--	552	22.06
Clay	22	316	1	12	--	--	20	444	668	104	--	--	772	22.02
Elliott	--	--	6	486	--	--	5	201	619	68	--	--	687	17.45
Floyd	109	2,918	10	359	6	206	35	2,066	4,997	534	--	18	5,549	18.39
Greenup	--	--	3	178	--	--	--	--	--	178	--	--	178	15.08
Harlan	74	8,212	--	--	9	159	44	1,918	10,091	187	--	12	10,289	26.32
Jackson	--	--	3	22	--	--	3	31	--	53	--	--	53	24.03
Johnson	4	140	10	580	--	--	22	600	1,206	114	--	--	1,320	22.50
Knott	73	3,311	5	85	2	18	28	1,185	4,354	241	--	--	4,594	21.10
Knox	6	30	27	683	--	--	39	793	1,262	244	--	--	1,506	23.91
Laurel	4	76	11	274	--	--	35	681	869	148	--	13	1,030	22.23
Lawrence	1	12	6	435	1	1	9	734	1,061	97	24	--	1,182	20.28
Lee	1	24	6	74	--	--	3	160	228	29	--	--	257	17.32
Leslie	23	1,667	10	202	1	10	34	1,226	2,891	213	--	--	3,104	22.43
Letcher	92	3,583	7	99	12	197	33	1,643	5,066	452	--	4	5,522	23.52
McCreary	3	699	2	157	--	--	3	15	852	19	--	--	871	25.27

See footnotes at end of table.

Table 18.—Production, shipments, and value at bituminous coal and lignite mines, in 1974, by State and county—Continued

(Thousand short tons)

State and county	Production								Shipments					
	Underground		Strip		Auger		Strip-auger							
	Number of mines	Quantity	Number of mines	Quantity	Number of mines	Quantity	Number of mines	Quantity	Rail or water [1]	Truck	Mine-mouth generating plants	All other [2]	Total [3]	Average value per ton [4]
Kentucky—Continued														
Eastern—Continued														
Magoffin	--	--	4	262	2	57	16	946	1,240	24	--	--	1,265	$23.56
Martin	16	2,353	15	3,048	1	2	17	1,264	6,619	47	--	--	6,666	15.52
Morgan	--	--	8	245	--	--	6	430	548	34	93	--	675	20.13
Owsley	--	--	2	115	--	--	6	202	287	29	--	--	317	27.52
Perry	30	2,173	8	232	--	--	53	3,024	5,359	70	--	--	5,429	25.42
Pike	281	13,675	28	1,734	38	861	91	4,979	20,052	1,154	21	22	21,249	25.03
Pulaski	2	128	2	306	--	--	2	20	350	104	--	--	454	W
Rockcastle	1	2	1	26	--	--	2	8	--	35	--	--	35	W
Wayne	1	6	1	12	--	--	2	29	18	29	--	--	46	18.92
Whitley	12	215	8	212	--	--	49	1,326	1,575	180	--	--	1,754	23.29
Wolfe	--	--	1	12	--	--	1	2	--	14	--	--	14	16.19
Total [3]	774	40,509	221	16,503	73	1,546	616	26,798	80,548	4,601	138	69	85,356	22.01
Western:														
Butler	1	52	9	211	--	--	--	--	132	131	--	--	263	8.34
Christian	--	--	4	215	--	--	--	--	182	33	--	--	215	9.51
Daviess	--	--	1	982	--	--	--	--	58	--	924	--	982	7.87
Edmonson	--	--	1	11	--	--	--	--	11	--	--	--	11	7.87
Hancock	--	--	1	43	--	--	--	--	--	43	--	--	43	7.87
Henderson	2	800	--	--	--	--	--	--	--	770	30	--	800	W
Hopkins	11	5,787	19	4,294	--	--	--	--	9,852	230	--	--	10,081	10.68
McLean	--	--	4	887	--	--	--	--	887	--	--	--	887	W
Muhlenberg	5	4,719	14	17,194	--	--	--	--	16,141	15	5,758	--	21,913	7.43
Ohio	8	3,051	20	5,007	--	--	--	--	7,916	141	--	--	8,057	8.64
Union	6	6,903	--	--	--	--	--	--	6,711	192	--	--	6,903	W
Webster	1	1,675	3	8	--	--	--	--	1,675	8	--	--	1,684	W
Total [3]	29	22,988	76	28,853	--	--	--	--	43,565	1,563	6,713	--	51,841	8.92
Total Kentucky	803	63,497	297	45,356	73	1,546	616	26,798	124,113	6,164	6,851	69	137,197	17.06
Maryland:														
Allegany	--	--	25	672	--	--	3	65	343	394	--	--	737	21.37
Garrett	1	90	30	1,345	--	--	3	165	1,276	323	--	--	1,600	20.54
Total [3]	1	90	55	2,017	--	--	6	230	1,619	718	--	--	2,337	20.81

Missouri:														
Barton	--	--	1	501	--	--	--	--	--	--	501	--	501	W
Bates	--	--	1	974	--	--	--	--	--	--	974	--	974	W
Henry	--	--	2	1,609	--	--	--	--	537	23	1,049	--	1,609	W
Howard	--	--	1	3	--	--	--	--	--	--	3	--	3	11.48
Macon	--	--	1	811	--	--	--	--	811	--	--	--	811	W
Putnam	--	--	1	179	--	--	--	--	179	--	--	--	179	3.90
Randolph	--	--	1	438	--	--	--	--	--	--	438	--	438	W
Vernon	--	--	2	108	--	--	--	--	106	1	--	--	108	W
Total [3]	--	--	10	4,623	--	--	--	--	1,633	25	2,965	--	4,623	6.36
Montana (bituminous):														
Big Horn	--	--	2	8,315	--	--	--	--	8,315	--	--	--	8,315	W
Musselshell	--	--	2	20	--	--	--	--	--	20	--	--	20	12.17
Rosebud	--	--	2	5,440	--	--	--	--	5,440	--	--	--	5,440	W
Total [3]	--	--	6	13,775	--	--	--	--	13,755	20	--	--	13,775	3.91
Montana (lignite):														
Powder River	--	--	1	1	--	--	--	--	--	1	--	--	1	W
Richland	--	--	1	330	--	--	--	--	329	(5)	--	--	330	W
Total [3]	--	--	2	331	--	--	--	--	329	2	--	--	331	W
Total Montana [3]	--	--	8	14,106	-	--	--	--	14,084	22	--	--	14,106	3.90
New Mexico:														
Colfax	1	529	1	363	--	--	--	--	891	--	--	--	891	W
McKinley	--	--	2	628	--	--	--	--	625	2	--	1	628	W
San Juan	--	--	2	7,873	--	--	--	--	--	--	7,873	--	7,873	W
Total [3]	1	529	5	8,864	--	--	--	--	1,516	2	7,873	1	9,392	W
North Dakota (lignite):														
Adams	--	--	2	24	--	--	--	--	--	24	--	--	24	W
Bowman	--	--	1	223	--	--	--	--	166	56	--	(5)	223	W
Burke	--	--	1	348	--	--	--	--	324	24	--	--	348	W
Grant	--	--	1	5	--	--	--	--	--	5	--	--	5	2.08
Mercer	--	--	3	4,062	--	--	--	--	2,423	2	1,626	11	4,062	2.23
Oliver	--	--	1	2,079	--	--	--	--	448	(5)	1,631	--	2,079	W
Stark	--	--	2	161	--	--	--	--	--	2	159	--	161	W
Ward	--	--	1	548	--	--	--	--	218	--	330	--	548	W
Williams	--	--	1	12	--	--	--	--	--	12	--	--	12	W
Total [3]	--	--	13	7,463	-	--	--	--	3,579	126	3,746	12	7,463	2.19
Ohio:														
Athens	--	--	1	37	--	--	--	--	-	37	--	--	37	12.70
Belmont	7	6,083	41	5,569	3	26	2	4,227	14,370	1,496	39	--	15,905	11.92
Carroll	--	--	2	217	--	--	--	--	--	217	--	--	217	12.70
Columbiana	3	48	18	607	2	22	3	107	102	682	--	--	784	12.77
Coshocton	1	738	11	1,117	1	33	--	--	357	770	767	--	1,894	13.24
Gallia	--	--	2	108	1	2	--	--	69	40	--	--	110	8.85

See footnotes at end of table.

Table 18.—Production, shipments, and value at bituminous coal and lignite mines, in 1974, by State and county—Continued

(Thousand short tons)

State and county	Production								Shipments					
	Underground		Strip		Auger		Strip-auger							
	Number of mines	Quantity	Number of mines	Quantity	Number of mines	Quantity	Number of mines	Quantity	Rail or water [1]	Truck	Mine-mouth generating plants	All other [2]	Total [3]	Average value per ton [4]
Ohio—Continued														
Guernsey	--	--	5	865	--	--	--	--	819	46	--	--	865	W
Harrison	5	2,969	13	1,588	--	--	2	1,121	5,464	213	--	--	5,678	$12.43
Hocking	--	--	7	304	--	--	--	--	14	229	62	--	304	9.80
Holmes	--	--	4	348	--	--	1	351	--	699	--	--	699	10.95
Jackson	3	63	6	407	--	--	--	--	1	469	--	--	470	12.09
Jefferson	2	772	25	3,355	4	92	2	913	2,521	2,290	321	--	5,132	13.11
Lawrence	--	--	3	92	--	--	--	--	72	21	--	(5)	92	13.27
Mahoning	--	--	8	425	--	--	1	57	--	475	--	7	482	14.56
Meigs	2	784	--	--	--	--	--	--	--	--	748	36	784	W
Monroe	1	824	--	--	--	--	--	--	824	--	--	--	824	W
Morgan	--	--	1	531	--	--	--	--	--	--	531	--	531	10.87
Muskingum	1	33	8	1,443	1	78	3	2,917	404	1,569	2,491	6	4,471	11.48
Noble	--	--	4	780	--	--	--	--	--	462	318	--	780	11.95
Perry	1	1,967	6	199	--	--	--	--	1,363	802	--	--	2,166	W
Stark	--	--	9	429	--	--	--	--	16	412	--	--	429	12.84
Tuscarawas	--	--	16	1,228	2	11	2	236	66	1,408	--	--	1,475	12.95
Vinton	2	78	8	1,158	--	--	--	--	575	654	7	--	1,236	10.72
Wayne	--	--	1	46	--	--	--	--	--	46	--	--	46	W
Total [3]	28	14,365	199	20,852	14	265	16	9,928	27,037	13,038	5,285	50	45,409	12.32
Oklahoma:														
Craig	--	--	3	866	--	--	--	--	678	189	--	4	866	W
Haskell	--	--	3	221	--	--	1	165	383	2	--	(5)	386	19.65
Le Flore	--	--	2	18	--	--	--	--	16	--	--	2	18	14.00
Muskogee	--	--	1	74	--	--	--	--	62	12	--	--	74	13.41
Pittsburg	--	--	1	7	--	--	--	--	7	--	--	--	7	8.67
Rogers	--	--	3	1,005	--	--	--	--	981	24	--	--	1,005	W
Total [3]	--	--	13	2,191	--	--	1	165	2,122	227	--	7	2,356	10.51
Pennsylvania:														
Allegheny	8	3,211	15	450	--	--	--	--	2,762	892	4	2	3,661	19.85
Armstrong	10	3,422	77	2,479	9	61	11	731	2,011	1,843	2,562	277	6,693	16.31
Beaver	1	182	3	24	--	--	--	--	122	85	--	--	206	18.54
Bedford	--	--	2	53	--	--	--	--	--	53	--	--	53	W
Blair	--	--	1	2	--	--	--	--	2	--	--	--	2	18.50
Butler	3	103	38	1,293	6	105	1	65	925	638	--	3	1,566	19.02
Cambria	18	5,586	40	2,087	--	--	--	--	5,875	1,786	--	13	7,673	26.39
Centre	1	476	12	541	--	--	--	--	671	345	--	--	1,016	16.79
Clarion	--	--	85	5,191	--	--	--	--	3,498	1,692	--	(5)	5,191	18.32

Clearfield	5	782	146	6,851	1	5	9	310	3,983	3,135	730	101	7,948	17.40
Clinton	--	--	7	459	--	--	--	--	247	212	--	--	459	21.92
Elk	--	--	29	794	3	18	3	64	169	706	--	(5)	876	16.53
Fayette	3	709	65	2,021	1	5	--	--	1,819	910	(5)	6	2,735	19.33
Greene	17	7,463	24	808	--	--	--	--	7,776	485	3	7	8,271	24.98
Huntingdon	--	--	1	2	--	--	--	--	--	2	--	--	2	W
Indiana	25	7,020	40	2,017	4	52	1	18	4,139	1,912	3,055	1	9,107	16.91
Jefferson	4	78	40	1,609	2	25	1	30	1,281	374	86	1	1,742	16.74
Lawrence	--	--	16	437	1	3	4	77	--	478	39	(5)	517	16.69
Lycoming	--	--	4	457	--	--	--	--	--	457	--	(5)	457	11.27
Mercer	--	--	2	813	--	--	--	--	45	267	--	--	813	20.00
Somerset	19	1,314	100	3,905	1	3	3	304	3,626	1,894	--	5	5,526	19.76
Tioga	--	--	5	455	--	--	--	--	--	455	--	--	455	8.02
Venango	--	--	11	495	--	--	--	--	--	495	--	--	495	13.85
Washington	14	10,881	48	2,127	--	--	--	--	11,899	1,602	--	7	13,008	23.71
Westmoreland	4	1,027	52	1,463	--	--	--	--	1,170	1,307	--	13	2,489	21.14
Total [3]	132	42,249	868	36,332	28	281	38	1,600	51,521	22,026	6,479	436	80,462	20.35
Tennessee:														
Anderson	22	1,179	7	546	2	8	1	50	440	1,348	--	--	1,788	15.96
Bledsoe	--	--	1	9	--	--	--	--	7	2	(5)	--	9	W
Campbell	7	61	18	863	--	--	2	515	1,301	125	--	13	1,439	20.02
Claiborne	2	957	8	619	--	--	--	--	1,552	24	--	(5)	1,577	15.97
Cumberland	--	--	1	2	--	--	--	--	--	2	--	--	2	20.89
Fentress	--	--	3	10	--	--	--	--	--	10	--	--	10	19.66
Grundy	--	--	5	47	--	--	--	--	6	40	--	--	47	23.23
Marion	6	408	--	--	--	--	--	--	348	60	--	--	408	14.69
Morgan	--	--	6	433	--	--	1	58	185	306	--	(5)	492	20.23
Putnam	1	100	--	--	--	--	--	--	--	100	--	--	100	W
Roane	--	--	--	--	1	21	--	--	--	21	--	--	21	W
Scott	5	109	13	724	--	--	2	308	1,049	91	--	--	1,141	22.11
Sequatchie	6	291	2	159	--	--	--	--	327	123	--	--	450	17.75
Van Buren	1	2	1	40	--	--	--	--	30	12	--	--	42	W
White	--	--	1	21	--	--	--	--	15	7	--	--	21	W
Total [3]	50	3,106	66	3,475	3	29	6	931	5,260	2,267	(5)	14	7,541	18.02
Texas:														
Freestone	--	--	1	5,137	--	--	--	--	--	--	5,137	--	5,137	W
Harrison	--	--	1	258	--	--	--	--	--	258		--	258	W
Milam	--	--	1	2,000	--	--	--	--	--	--	2,000	--	2,000	W
Titus	--	--	1	289	--	--	--	--	--	--	289	--	289	W
Total [3]	--	--	4	7,684	--	--	--	--	--	258	7,426	--	7,684	W
Utah:														
Carbon	9	2,958	--	--	--	--	--	--	2,474	476		8	2,958	15.66
Emery	5	2,534	--	--	--	--	--	--	1,304	512	714	4	2,534	8.73
Sevier	1	366	--	--	--	--	--	--	145	221	--	--	366	W
Total [3]	15	5,858	--	--	--	--	--	--	3,923	1,209	714	11	5,858	12.24

See footnotes at end of table.

Table 18.—Production, shipments, and value at bituminous coal and lignite mines, in 1974, by State and county—Continued

(Thousand short tons)

State and county	Production								Shipments					Average value per ton [4]
	Underground		Strip		Auger		Strip-auger		Rail or water [1]	Truck	Mine-mouth generating plants	All other [2]	Total [3]	
	Number of mines	Quantity	Number of mines	Quantity	Number of mines	Quantity	Number of mines	Quantity						
Virginia:														
Buchanan	219	10,253	78	2,351	26	688	9	976	11,456	2,792	--	20	14,268	$26.85
Dickenson	35	3,989	34	1,164	1	13	4	358	5,450	74	--	--	5,524	24.70
Lee	17	702	8	44	--	--	6	206	902	50	--	--	952	25.08
Russell	9	1,327	15	311	--	--	3	185	1,633	189	--	--	1,822	26.23
Scott	2	8	--	--	--	--	--	--	--	8	--	--	8	26.19
Tazewell	22	1,604	6	298	--	--	2	45	1,708	239	--	--	1,947	22.64
Wise	46	4,883	117	3,707	7	67	16	1,147	9,277	524	--	4	9,805	22.50
Total [3]	350	22,767	258	7,874	34	767	40	2,918	30,426	3,876	--	23	34,326	24.94
Washington:														
King	1	15	--	--	--	--	--	--	--	15	--	--	15	W
Lewis	--	--	2	2,342	--	--	--	--	--	8	2,334	--	2,342	W
Thurston	--	--	(6)	1,556	--	--	--	--	--	--	1,556	--	1,556	W
Total [3]	1	15	2	3,898	--	--	--	--	--	23	3,890	-	3,913	W
West Virginia:														
Barbour	11	1,218	20	1,855	--	--	3	622	3,477	218	--	--	3,695	17.85
Boone	49	7,661	15	1,584	--	--	3	178	9,274	138	--	12	9,423	22.75
Braxton	2	11	--	--	--	--	--	--	9	2	--	--	11	15.18
Brooke	2	603	3	98	--	--	--	--	642	53	--	6	701	16.57
Clay	6	57	1	22	--	--	--	--	79	--	--	--	79	21.64
Fayette	26	2,208	15	520	1	3	--	--	2,684	45	--	3	2,731	24.94
Grant	3	1,231	10	284	--	--	1	24	1,287	178	75	--	1,539	14.95
Greenbrier	13	215	11	366	--	--	--	--	578	4	--	--	581	32.26
Gilmer	1	1	1	65	--	--	--	--	65	1	--	--	66	16.83
Harrison	6	3,100	14	282	1	11	5	578	1,519	29	2,417	--	3,965	12.66
Kanawha	40	5,243	20	2,332	6	112	4	148	7,612	220	--	2	7,834	21.04
Lewis	1	1	--	--	1	7	15	581	577	12	--	--	589	15.85
Lincoln	2	5	--	--	--	--	--	--	5	--	--	--	5	W
Logan	62	6,942	3	506	--	--	6	519	7,578	388	--	1	7,967	26.69
McDowell	84	9,814	9	328	--	--	1	87	9,921	191	--	66	10,179	29.57
Marion	8	4,524	--	--	--	--	--	--	4,442	22	17	44	4,524	17.78
Marshall	4	4,935	--	--	--	--	--	--	1,886	64	2,985	--	4,935	W
Mason	2	146	--	--	--	--	--	--	--	14	133	--	146	W
Mercer	3	991	3	43	1	11	--	--	1,043	--	--	2	1,046	W
Mineral	1	110	4	212	--	--	3	100	409	13	--	--	422	12.78
Mingo	43	3,218	--	--	--	--	5	555	3,556	62	--	155	3,773	20.28
Monongalia	17	9,678	8	1,073	--	--	--	--	10,584	153	4	11	10,752	12.79
Nicholas	45	4,343	14	1,050	--	--	7	397	5,763	27	--	--	5,790	21.77
Ohio	2	1,581	--	--	--	--	--	--	1,426	117	37	--	1,581	W

Preston	12	836	32	2,056	--	--	--	--	1,800	1,077	15	--	2,893	16.98
Raleigh	39	4,672	12	614	1	12	--	--	4,951	289	13	46	5,298	31.51
Randolph	7	183	12	867	--	--	--	--	1,044	6	--	--	1,050	31.66
Summers	4	51	--	--	--	--	--	--	26	25	--	--	51	18.52
Taylor	--	--	3	96	--	--	--	--	96	--	--	--	96	14.60
Tucker	--	--	8	318	--	--	--	--	318	--	--	--	318	32.96
Upshur	3	584	10	935	--	--	5	278	1,750	43	--	--	1,792	21.41
Wayne	2	449	--	--	--	--	--	--	444	6	--	--	449	22.57
Webster	7	99	8	72	1	121	1	36	325	4	--	--	329	21.98
Wyoming	77	7,508	3	181	4	138	3	26	7,597	238	--	18	7,853	28.00
Total [3]	584	82,220	229	15,758	16	415	62	4,070	92,767	3,635	5,695	364	102,462	21.65
Wyoming:														
Campbell	--	----	2	4,051	--	--	--	--	3,837	10	202	2	4,051	W
Carbon	2	418	5	8,325	--	--	--	--	8,740	--	--	3	8,743	6.07
Converse	--	--	1	2,687	--	--	--	--	--	--	2,687	--	2,687	W
Hot Springs	2	6	1	1	--	--	--	--	2	5	---	--	7	W
Lincoln	--	--	2	3,353	--	--	--	--	916	--	2,437	(5)	3,353	W
Sheridan	--	--	2	1,023	--	--	--	--	999	24	--	--	1,023	W
Sweetwater	1	103	1	735	--	--	--	--	23	--	735	80	838	W
Total [3]	5	526	14	20,176	--	--	--	--	14,518	39	6,061	84	20,703	5.02
Total United States [3]	2,039	277,309	2,254	275,041	168	3,302	786	47,755	464,915	66,382	66,635	5,474	603,406	15.75

[e] Estimate. W Withheld to avoid disclosing individual company confidential data.

[1] Includes coal loaded at mine directly into railroad cars or river barges, hauled by trucks to railroad sidings, and hauled by trucks to waterways.

[2] Includes coal used at mine for power and heat, made into beehive coke at mine, used by mine employees, used for all other purposes at mine, and shipped by slurry pipeline in Arizona.

[3] Data may not add to totals shown because of independent rounding.

[4] Value at average prices that might have been received if such had been sold commercially.

[5] Less than 500 tons.

[6] This is an extension of mine counted in Lewis County.

Table 19.—Underground mine data for bituminous coal, in 1974, by State
(Thousand short tons)

State	Number of mines	Production	Cut by hand and shot from solid	Cut by machines			Mined by continuous mining machines	Mined by longwall machines	Number of power drills and production										
				Quantity	Number of coal cutting machines	Average output per machine			Number of mines using power drills	Face or coal drills				Roof or rock drills					
										Handheld and post mounted		Mobile		Roof bolting			Other uses		
										Number	Quantity	Number	Quantity	Rotary	Percussion	Rotary percussion	Rotary	Percussion	Rotary percussion
Alabama	19	7,053	6	5,551	58	96	1,497	--	17	9	601	49	4,950	68	2	6	--	--	--
Colorado	23	3,260	5	36	5	7	3,039	180	9	4	25	--	--	22	19	2	--	--	--
Illinois	23	31,256	--	6,616	35	189	24,640	--	28	5	732	30	5,884	237	2	--	--	--	--
Indiana	2	139	--	139	2	70	--	--	2	--	--	2	139	2	--	--	--	--	--
Iowa	2	379	--	379	2	190	--	--	2	--	--	2	379	1	--	--	--	--	--
Kentucky:																			
Eastern	774	40,509	3,572	17,832	441	40	18,870	235	650	565	8,233	254	12,646	458	29	38	4	--	2
Western	29	22,988	--	22,229	111	200	759	--	29	2	173	109	22,056	149	8	18	--	--	--
Total[1]	803	63,497	3,572	40,061	552	73	19,630	235	679	567	8,405	363	34,702	607	37	51	4	--	2
Maryland	1	90	--	--	--	--	90	--	1	2	--	--	--	--	--	--	--	--	--
New Mexico	1	529	--	--	--	--	346	183	1	--	--	--	--	6	--	--	1	--	--
Ohio	28	14,365	--	4,833	45	107	9,532	--	27	6	453	39	4,380	243	7	2	--	--	--
Pennsylvania	132	42,249	11	1,294	47	28	37,683	3,262	122	28	383	18	907	364	166	144	--	--	1
Tennessee	50	3,106	46	1,948	46	42	1,112	--	48	37	1,026	18	966	34	--	--	--	--	--
Utah	15	5,858	--	465	4	116	4,582	812	12	--	--	8	465	12	13	7	--	--	2
Virginia	350	22,767	1,165	7,617	235	32	12,393	1,592	328	151	2,787	176	5,848	342	111	3	--	--	--
Washington	1	15	15	--	--	--	--	--	--	6	15	--	--	--	1	--	--	--	--
West Virginia	584	82,220	128	22,495	481	47	56,285	3,312	557	266	5,478	269	17,036	1,046	119	90	--	--	--
Wyoming	5	526	--	57	3	19	469	--	4	1	3	1	3	3	--	3	--	--	--
Total[1]	2,039	277,309	4,947	91,490	1,515	60	171,297	9,574	1,827	1,080	19,909	970	75,658	2,987	477	308	5	--	5

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[1] Data may not add to totals shown because of independent rounding.

Table 20.—Haulage units in use in bituminous coal underground mines in the United States, in 1974, by State

State	Railroad			Rubber-tired vehicles					Gathering and haulage conveyors	
	Locomotives		Mine cars	Tractors	Trailers	Shuttle cars		Shuttle buggies		
	Trolley	Battery				Cable reel	Battery		Units	Miles
Alabama	115	--	1,781	62	62	182	7	4	133	54.1
Colorado	47	6	967	18	2	102	--	1	51	15.9
Illinois	96	36	164	179	--	415	10	--	331	169.5
Indiana	2	--	34	--	--	5	--	--	--	--
Iowa	5	--	51	--	--	6	--	--	--	--
Kentucky:										
Eastern	219	18	6,030	583	--	897	166	184	897	216.3
Western	46	57	94	111	--	270	40	--	210	79.6
Total	265	75	6,124	694	--	1,167	206	184	1,107	295.9
Maryland	--	--	--	--	--	2	--	--	2	.2
New Mexico	--	--	--	--	--	10	--	--	12	6.8
Ohio	93	19	2,273	114	175	258	27	--	186	66.8
Pennsylvania	981	29	11,551	284	159	1,116	35	5	738	281.2
Tennessee	16	6	236	58	106	54	7	18	64	17.8
Utah	55	--	1,201	25	47	91	--	--	96	25.8
Virginia	183	13	2,238	322	769	399	121	95	618	212.3
Washington	1	--	20	--	--	1	--	--	--	--
West Virginia	990	61	20,140	503	393	2,420	237	79	1,546	473.5
Wyoming	1	--	20	6	1	13	--	--	8	2.0
Total	2,850	245	46,800	2,265	1,714	6,241	650	386	4,892	1,621.8

Table 21.—Number and production of underground bituminous coal mines using gathering and haulage conveyors, and number and length of units in use, by State [1]

State	Number of mines		Production (thousand short tons)		Number of units in use		Average length (feet)		Total length (miles)	
	1973	1974	1973	1974	1973	1974	1973	1974	1973	1974
Alabama	7	15	6,266	7,024	95	133	2,023	2,146	36.4	54.1
Arkansas	1	--	3	--	4	--	500	--	.4	--
Colorado	8	19	1,822	3,223	48	51	1,318	1,641	12.0	15.9
Illinois	21	22	30,259	31,156	293	331	2,758	2,704	153.0	169.5
Indiana	1	--	614	--	14	--	1,500	--	4.0	--
Kentucky:										
Eastern	116	359	24,606	32,832	417	897	2,030	1,273	160.3	216.3
Western	24	29	22,239	22,988	194	210	2,230	2,002	81.9	79.6
Total	140	388	46,845	55,820	611	1,107	2,094	1,411	242.2	295.9
Maryland	1	1	5	90	1	2	2,500	500	.5	.2
New Mexico	1	1	733	529	12	12	3,000	3,000	6.8	6.8
Ohio	19	21	13,894	13,981	145	186	1,967	1,895	54.0	66.8
Pennsylvania	81	89	28,519	30,805	717	738	2,059	2,012	279.6	281.2
Tennessee	10	21	2,173	2,305	46	64	1,796	1,466	15.6	17.8
Utah	12	14	1,940	5,676	66	96	1,507	1,420	18.8	25.8
Virginia	90	194	16,754	18,517	465	618	2,063	1,814	181.7	212.3
West Virginia	292	447	83,800	76,663	1,376	1,546	1,970	1,617	513.4	473.5
Wyoming	3	3	415	520	9	8	1,689	1,318	2.9	2.0
Total [2]	687	1,235	234,042	246,309	3,902	4,892	2,059	2,070	1,521.3	1,621.8

[1] Includes all mines using belt conveyors 500 feet long or more for transporting coal underground.
[2] Data may not add to totals shown because of independent rounding.

Table 22.—Bituminous coal mechanically loaded underground in the United States, by type of loading equipment

(Thousand short tons)

Type of loading equipment	1973	1974
Mobile loading machines:		
Direct into mine cars or onto conveyors	13,537	7,173
Into shuttle cars	95,804	81,991
Continuous-mining machines:		
Onto conveyors	10,178	7,766
Into shuttle or mine cars	140,207	141,968
Onto bottom	28,215	21,563
Longwall machines	9,442	9,574
Scoops	(1)	6,564
Total	[2] 297,384	276,599

[1] Included with mobile loading machines in 1973.
[2] Data do not add to total shown because of independent rounding.

Table 23.—Comparative changes in underground mechanical loading of bituminous coal by principal types of loading devices in the United States, by State

(Thousand short tons)

State	Mobile loading machines		Continuous-mining machines		Longwall machines		Scoops		Total mechanically loaded[1]	
	1973	1974	1973	1974	1973	1974	1973[2]	1974	1973	1974
Alabama	6,729	5,527	847	1,497	--	--	--	--	7,576	7,024
Colorado	54	22	2,982	3,039	312	180	--	5	3,347	3,246
Illinois	5,716	6,616	26,833	24,640	21	--	--	--	32,570	31,256
Indiana	174	139	614	--	--	--	--	--	789	139
Iowa	356	379	--	--	--	--	--	--	356	379
Kentucky:										
Eastern	25,522	16,863	13,831	18,870	187	235	--	4,187	39,540	40,155
Western	22,342	22,213	--	759	--	--	--	16	22,342	22,988
Total[1]	47,864	39,076	13,831	19,630	187	235	--	4,203	61,883	63,143
Maryland	--	--	66	90	--	--	--	--	66	90
New Mexico	--	--	611	346	122	183	--	--	733	529
Ohio	5,292	4,833	10,933	9,532	--	--	--	--	16,225	14,365
Pennsylvania	1,743	1,233	41,611	37,683	2,749	3,262	--	--	46,103	42,177
Tennessee	2,230	1,660	1,366	1,112	--	--	--	295	3,596	3,068
Utah	469	98	4,217	4,582	814	812	--	366	5,500	5,858
Virginia	10,116	7,417	11,317	12,393	1,733	1,592	--	1,239	23,167	22,641
Washington	16	15	--	--	--	--	--	--	16	15
West Virginia	28,474	22,094	63,057	56,285	3,503	3,312	--	456	95,034	82,147
Wyoming	107	54	315	469	--	--	--	--	422	523
Total[1]	109,342	89,164	178,600	171,297	9,442	9,574	--	6,564	297,384	276,599

[1] Data may not add to totals shown because of independent rounding.

[2] Included in mobile loading machines in 1973.

Table 24.—Number of loading units used in bituminous coal underground mines, by State

State	Mobile loading machines		Continuous-mining machines		Longwall machines		Scoops		Total	
	1973	1974	1973	1974	1973	1974	1973 [1]	1974	1973	1974
Alabama	72	62	9	23	--	--	--	--	81	85
Colorado	r 14	11	41	34	1	2	--	4	r 56	51
Illinois	29	41	156	138	1	--	--	--	186	179
Indiana	2	2	5	--	--	--	--	--	7	2
Iowa	4	3	--	--	--	--	--	--	4	3
Kentucky:										
Eastern	r 551	378	152	218	1	1	--	381	r 704	978
Western	139	118	--	5	--	--	--	1	139	124
Total	690	496	152	223	1	1	--	382	843	1,102
Maryland	--	--	2	1	--	--	--	--	2	1
New Mexico	r 5	5	5	5	1	1	--	--	r 11	11
Ohio	57	45	103	100	--	--	--	--	160	145
Pennsylvania	r 75	43	494	442	14	15	--	--	r 583	500
Tennessee	62	30	8	17	--	--	--	17	70	64
Utah	r 8	4	35	38	3	3	--	5	r 46	50
Virginia	294	233	180	202	11	10	--	97	485	542
Washington	1	1	--	--	--	--	--	--	1	1
West Virginia	r 697	630	673	730	18	21	--	38	r 1,388	1,419
Wyoming	5	2	3	6	--	--	--	--	8	8
Total	r 2,015	1,608	1,866	1,959	50	53	--	543	r 3,931	4,168

r Revised.

[1] Included in mobile loading machines in 1973.

Table 25.—Production at underground bituminous coal mines, by State and method of loading

(Thousand short tons)

State	Hand-loaded		Mechanically loaded		Total underground production[1]	
	1973	1974	1973	1974	1973	1974
Alabama	42	29	7,576	7,024	7,618	7,053
Arkansas	3	--	--	--	3	--
Colorado	13	14	3,347	3,246	3,361	3,260
Illinois	--	--	32,570	31,256	32,570	31,256
Indiana	--	--	789	139	789	139
Iowa	--	--	356	379	356	379
Kentucky:						
Eastern	1,012	354	39,540	40,155	40,553	40,509
Western	--	--	22,342	22,988	22,342	22,988
Total[1]	1,012	354	61,883	63,148	62,895	63,497
Maryland	--	--	66	90	66	90
Montana	1	--	--	--	1	--
New Mexico	--	--	733	529	733	529
Ohio	--	--	16,225	14,365	16,225	14,365
Pennsylvania	104	72	46,103	42,177	46,207	42,249
Tennessee	40	38	3,596	3,068	3,636	3,106
Utah	--	--	5,500	5,858	5,500	5,858
Virginia	270	127	23,167	22,641	23,437	22,767
Washington	--	--	16	15	16	15
West Virginia	482	73	95,034	82,147	95,516	82,220
Wyoming	3	3	422	523	425	526
Total[1]	1,970	710	297,384	276,599	299,353	277,309

[1] Data may not add to totals shown because of independent rounding.

Table 26.—Number and production of bituminous coal and lignite strip mines and units of stripping and loading equipment, in 1974, by State

State	Number of strip mines	Production (thousand short tons)	Number of power shovels and dragline excavators											Number of carry-all scrapers	Number of bulldozers	Number of front-end loaders	Number of wheel excavators	Number of power brooms	Number of motor graders	Number of coal drills
			By type of power				By capacity of dipper or bucket, cubic yards				By type of machine									
			Electric	Diesel electric	Diesel	Gasoline	Less than 6	6-15	16-50	More than 50	Power shovels	Dragline excavators	Total							
Alabama	116	11,656	20	45	81	1	58	60	27	2	65	82	147	24	287	269	--	9	28	4
Alaska	1	700	--	--	--	--	--	--	--	--	--	--	--	--	6	4	--	--	2	--
Arizona	2	6,448	3	1	--	--	--	2	1	1	1	3	4	1	11	3	--	--	2	3
Arkansas	7	455	1	3	6	--	2	8	--	--	1	9	10	--	17	12	--	2	8	--
Colorado	8	3,636	7	--	3	--	2	5	3	--	4	6	10	8	29	14	--	--	8	5
Illinois	32	26,960	72	4	30	--	35	35	17	19	56	50	106	25	206	57	10	--	36	21
Indiana	39	23,587	61	3	50	1	51	36	14	14	59	56	115	7	192	62	--	2	25	7
Iowa	6	211	--	2	5	--	7	--	--	--	2	5	7	5	8	6	--	--	--	5
Kansas	7	718	6	--	4	--	5	3	1	1	4	6	10	1	24	7	--	1	4	--
Kentucky:																				
Eastern	221	16,503	--	7	34	--	4	32	5	--	36	5	41	28	514	427	--	17	118	13
Western	76	28,853	58	5	67	1	64	36	19	12	73	58	131	22	328	146	--	2	50	8
Total	297	45,356	58	12	101	1	68	68	24	12	109	63	172	50	842	573	--	19	168	21
Maryland	55	2,017	--	4	67	--	56	15	--	--	32	39	71	3	88	81	--	--	10	3
Missouri	10	4,623	11	2	16	--	10	8	8	3	13	16	29	4	50	26	--	--	9	1
Montana:																				
Bituminous	6	13,775	10	--	--	--	--	2	7	1	5	5	10	11	20	11	--	--	5	7
Lignite	2	331	1	--	3	--	3	1	--	--	3	1	4	1	3	2	--	1	1	2
Total	8	14,106	11	--	3	--	3	3	7	1	8	6	14	12	23	13	--	1	6	9
New Mexico	5	8,864	5	1	1	--	--	6	1	--	2	5	7	10	25	17	--	--	11	5
North Dakota (lignite)	13	7,468	17	2	6	1	11	8	6	1	13	13	26	26	82	22	--	--	12	8
Ohio	199	20,852	17	19	277	3	227	80	6	3	180	136	316	198	686	375	--	18	103	11
Oklahoma	13	2,191	6	1	10	--	7	3	3	4	6	11	17	7	39	33	--	--	9	--
Pennsylvania	863	36,332	18	24	803	8	592	252	9	--	422	431	853	189	1,267	926	1	9	101	11
Tennessee	66	3,475	--	2	58	--	55	5	--	--	50	10	60	21	156	136	--	7	31	5
Texas	4	7,684	10	2	2	--	5	3	4	2	7	7	14	5	18	5	--	--	3	--
Virginia	258	7,874	--	--	77	--	77	--	--	--	77	--	77	29	424	388	--	7	34	7
Washington	2	3,898	5	--	1	--	1	1	3	1	3	3	6	14	22	5	--	--	2	--
West Virginia	229	15,758	1	4	208	4	180	37	--	--	142	75	217	42	627	451	--	17	133	46
Wyoming	14	20,176	19	2	5	1	7	9	9	2	12	15	27	50	66	24	--	1	20	14
Total	2,254	[1]275,041	348	133	1,814	20	1,459	647	143	66	1,268	1,047	2,315	781	5,145	3,509	11	93	765	186

[1] Data may not add to totals shown because of independent rounding.

Table 27.—Number and production of bituminous coal and lignite strip-auger mines and units of strip-auger and loading equipment, in 1974, by State

State	Number of strip-auger mines	Production (thousand short tons)	Number of augers	Number of power shovels and dragline excavators											Number of carryall scrapers	Number of bulldozers	Number of front-end loaders	Number of power brooms	Number of motor graders	Number of coal drills
				By type of power				By capacity of dipper or bucket, cubic yards				By type of machine								
				Electric	Diesel electric	Diesel	Gasoline	Less than 6	6–15	16–50	More than 50	Power shovels	Dragline excavators	Total						
Alabama	1	1,114,969	1	2	--	--	--	--	1	--	1	2	--	2	16	--	5	--	2	--
Kentucky:																				
Eastern	616	26,797,828	607	--	1	109	--	98	12	--	--	109	1	110	30	1,192	966	6	270	38
Western	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Total	616	26,797,828	607	--	1	109	--	98	12	--	--	109	1	110	30	1,192	966	6	270	38
Maryland	6	230,229	6	--	--	9	--	9	--	--	--	4	5	9	--	13	9	--	1	--
Ohio	16	9,927,580	15	13	5	11	--	5	16	6	2	18	11	29	39	121	35	1	14	1
Oklahoma	1	165,000	1	1	1	2	--	2	2	--	--	2	2	4	2	9	2	--	1	--
Pennsylvania	38	1,600,356	21	--	2	30	--	15	17	--	--	10	22	32	10	55	39	--	5	--
Tennessee	6	931,097	6	--	1	2	--	1	2	--	--	3	--	3	--	25	22	--	5	--
Virginia	40	2,917,914	36	--	--	16	--	16	--	--	--	14	2	16	1	95	69	--	13	1
West Virginia	62	4,069,842	65	1	--	46	1	42	6	--	--	35	13	48	5	159	126	6	41	11
Total	786	47,754,815	758	17	10	225	1	188	56	6	8	197	56	253	103	1,669	1,273	13	352	51

Table 28.—Equipment used at bituminous coal and lignite auger mines in the United States, in 1974

State	Number of auger mines	Production (thousand short tons)	Number of Units: Augers	Power shovels	Bull-dozers	Front-end loaders	Power brooms	Motor graders
Kentucky: Eastern	73	1,546	76	1	82	48	1	3
Ohio	14	264	14	--	14	7	--	--
Pennsylvania	28	281	22	1	19	8	--	--
Tennessee	3	29	3	--	1	3	--	--
Virginia	34	767	34	--	36	31	--	1
West Virginia	16	415	18	1	17	18	--	--
Total	168	3,302	167	3	169	115	1	4

Table 29.—Number of power drills used at bituminous coal and lignite mines in the United States, in 1974, by State

State	Horizontal: Strip	Horizontal: Auger	Horizontal: Strip-auger	Vertical: Strip	Vertical: Auger	Vertical: Strip-auger	Total
Alabama	21	--	--	122	--	3	146
Arizona	--	--	--	4	--	--	4
Arkansas	--	--	--	7	--	--	7
Colorado	3	--	--	5	--	--	8
Illinois	18	--	--	33	--	--	51
Indiana	15	--	--	36	--	--	51
Iowa	2	--	--	6	--	--	8
Kansas	5	--	--	2	--	--	7
Kentucky:							
Eastern	55	4	106	165	4	437	771
Western	16	--	--	97	--	--	113
Total	71	4	106	262	4	437	884
Maryland	3	--	--	14	--	3	20
Missouri	10	--	--	14	--	--	24
Montana (bituminous)	1	--	--	8	--	--	9
New Mexico	1	--	--	5	--	--	6
North Dakota (lignite)	--	--	--	2	--	--	2
Ohio	46	--	--	95	--	17	158
Oklahoma	4	--	--	7	--	--	11
Pennsylvania	53	--	1	208	--	7	269
Tennessee	18	--	--	49	--	8	75
Virginia	43	--	8	203	--	38	292
Washington	--	--	--	2	--	--	2
West Virginia	58	1	17	164	1	43	284
Wyoming	8	--	--	12	--	--	20
Total	375	5	132	1,260	5	561	2,338

Table 30.—Number of off-the-highway trucks in use at bituminous coal and lignite mines by capacity and method of dumping [1]

Capacity	End dump 1973	End dump 1974	Side dump 1973	Side dump 1974	Bottom dump 1973	Bottom dump 1974	All types 1973	All types 1974
Under 20 tons	652	533	--	3	53	42	705	578
20 to 50 tons	782	1,125	--	3	219	223	1,001	1,351
51 to 100 tons	96	182	--	3	323	338	419	523
Over 100 tons	23	33	--	--	227	283	250	316
Total	1,553	1,873	--	9	822	886	2,375	2,768

[1] Numbers represent only those trucks reported to the Bureau of Mines.

Table 31.—Mechanical cleaning at bituminous coal and lignite mines, in 1974 by State

(Thousand short tons)

State	Total production	Mechanical cleaning			
		Number of cleaning plants	Raw coal	Cleaned coal	Refuse
Alabama	19,824	22	18,099	11,726	6,372
Colorado	6,896	3	2,043	1,775	268
Illinois	58,215	36	58,520	45,313	13,207
Indiana	23,726	11	23,874	19,097	4,777
Kentucky:					
Eastern	85,356	43	33,503	24,304	9,199
Western	51,841	19	25,033	19,324	5,709
Total[1]	137,197	62	58,535	43,628	14,907
Ohio	45,409	17	19,142	13,617	5,525
Pennsylvania	80,462	68	57,676	41,302	16,374
Utah	5,858	6	3,890	3,401	488
Virginia	34,326	19	21,151	13,872	7,279
West Virginia	102,462	126	88,310	62,833	25,477
Other States[2]	89,030	17	12,093	8,584	3,509
Total[1]	603,406	387	363,334	265,150	98,184

[1] Data may not add to totals shown because of independent rounding.

[2] Includes Alaska, Arkansas, Iowa, Kansas, Maryland, Missouri, New Mexico, Oklahoma, Tennessee, Washington, and Wyoming.

Table 32.—Mechanical cleaning of bituminous coal and lignite, by type of equipment

(Thousand short tons)

Type of equipment	1973	1974
Wet methods:		
Jigs	132,655	129,302
Concentrating tables	34,935	28,869
Classifiers	3,297	2,698
Launders	5,121	3,577
Dense-medium processes:		
Magnetite	74,605	68,749
Sand	12,617	12,427
Calcium chloride	981	1,107
Total	88,203	82,283
Flotation	14,201	10,863
Total, wet methods[1]	278,413	257,592
Pneumatic methods	10,505	7,557
Grand total[1]	288,918	265,150

[1] Data may not add to totals shown because of independent rounding.

Table 33.—Mechanical cleaning at bituminous coal and lignite mines, in 1974, by State and type of mining

(Thousand short tons)

State	Underground mines		Strip mines		Auger mines		Strip-auger mines		Total all mines[1]	
	Total production	Cleaned	Total production	Cleaned	Total production	Cleaned	Total production	Cleaned	Total production	Cleaned
Alabama	7,053	7,037	11,656	3,745	--	--	1,115	945	19,824	11,726
Colorado	3,260	1,752	3,636	23	--	--	--	--	6,896	1,775
Illinois	31,256	21,589	26,960	23,724	--	--	--	--	58,215	45,313
Indiana	139	64	23,587	19,033	--	--	--	--	23,726	19,097
Kentucky:										
Eastern	40,509	22,126	16,503	427	1,546	517	26,798	1,234	85,356	24,304
Western	22,988	7,162	28,853	12,162	--	--	--	--	51,841	19,824
Total[1]	63,497	29,288	45,356	12,590	1,546	517	26,798	1,234	137,197	43,628
Ohio	14,365	8,826	20,852	4,792	265	--	9,928	--	45,409	13,617
Pennsylvania	42,249	34,118	36,332	7,161	281	23	1,600	--	80,462	41,302
Utah	5,858	3,401	--	--	--	--	--	--	5,858	3,401
Virginia	22,767	13,285	7,874	141	767	--	2,918	446	34,326	13,872
West Virginia	82,220	58,807	15,758	3,166	415	22	4,070	839	102,462	62,833
Other States[2]	4,645	1,858	83,030	6,726	29	--	1,326	--	89,030	8,584
Total[1]	277,309	180,024	275,041	81,100	3,302	562	47,755	3,463	603,406	265,150

[1] Data may not add to totals shown because of independent rounding.

[2] Includes Alaska, Arkansas, Kansas, Maryland, Missouri, New Mexico, Oklahoma, Tennessee, Washington, and Wyoming.

Table 34.—Preparation other than mechanical cleaning of bituminous coal and lignite at mines in 1974, by State

(Thousand short tons)

State	Crushed or screened	No processing
Alabama	7,514	644
Alaska	560	100
Arizona	6,448	--
Arkansas	285	5
Colorado	5,098	23
Illinois	12,660	242
Indiana	4,294	335
Iowa	568	22
Kansas	271	4
Kentucky	78,179	15,396
Maryland	1,841	496
Missouri	1,657	1,495
Montana	14,094	12
New Mexico	8,500	1
North Dakota (lignite)	7,366	97
Ohio	21,337	10,468
Oklahoma	1,996	21
Pennsylvania	30,400	8,780
Tennessee	5,160	1,138
Texas	7,426	258
Utah	2,458	4
Virginia	18,837	1,617
Washington	--	8
West Virginia	36,451	3,190
Wyoming	20,602	20
Total	293,997	[1] 44,372

[1] Data do not add to total shown because of independent rounding.

Table 35.—Thermal drying of bituminous coal and lignite, by type of drying equipment

Type of dryer	Number of thermal drying units		Thermally dried (thousand short tons)	
	1973	1974	1973	1974
Fluidized-bed	66	56	30,907	24,616
Multilouver	16	12	1,616	3,006
Rotary	36	3	5,519	697
Screen	12	5	2,484	1,960
Suspension or flash	31	30	5,575	5,766
Vertical tray and cascade	1	--	100	--
Total	162	106	[1] 46,202	36,045

[1] Data do not add to total shown because of independent rounding.

Table 36.—Comparison of thermal drying of bituminous coal and lignite with mechanical cleaning at mines, by State

State	Number of cleaning plants				Thousand short tons			
	Total		With thermal drying		Production mechanically cleaned		Thermally dried	
	1973	1974	1973	1974	1973	1974	1973	1974
Alabama	19	22	1	--	11,705	11,726	818	--
Colorado	3	3	1	1	1,662	1,775	391	1,098
Illinois	36	36	7	5	48,091	45,318	5,155	4,078
Indiana	10	11	2	--	19,699	19,097	2,181	--
Kentucky:								
Eastern	33	43	9	6	22,264	24,304	3,358	2,086
Western	18	19	3	1	20,005	19,324	547	246
Total[1]	51	62	12	7	42,269	43,628	3,904	2,332
North Dakota (lignite)	--	--	2	1	--	--	115	18
Ohio	17	17	4	3	14,588	13,617	1,381	601
Pennsylvania	68	68	9	5	45,731	41,302	5,393	1,987
Tennessee	--	--	--	1	--	--	--	198
Texas	--	--	--	1	--	--	--	2,000
Utah	7	6	1	2	3,575	3,401	982	1,998
Virginia	32	19	10	7	17,696	13,872	4,421	5,006
West Virginia	124	126	45	35	75,672	62,833	21,461	16,738
Other States	15	17	--	--	8,230	8,584	--	--
Total[1]	382	387	94	68	288,918	265,150	46,202	36,045

[1] Data may not add to totals shown because of independent rounding.

Table 37.—Thermal drying of bituminous coal and lignite at mines, by State

State	Number of thermal drying units		Grand total production (thousand short tons)		Thermally dried (thousand short tons)	
	1973	1974	1973	1974	1973	1974
Alabama	3	--	19,230	19,824	818	--
Colorado	1	1	6,233	6,896	391	1,098
Illinois	11	6	61,572	58,215	5,155	4,078
Indiana	11	--	25,253	23,726	2,181	--
Kentucky:						
Eastern	11	6	73,966	85,356	3,358	2,086
Western	7	1	53,679	51,841	547	246
Total[1]	18	7	127,645	137,197	3,904	2,332
North Dakota (lignite)	2	1	6,906	7,463	115	18
Ohio	13	6	45,783	45,409	1,381	601
Pennsylvania	13	6	76,403	80,462	5,393	1,987
Tennessee	--	1	8,219	7,541	--	198
Texas	--	9	6,944	7,684	--	2,000
Utah	1	3	5,500	5,858	982	1,998
Virginia	21	16	33,961	34,326	4,421	5,006
West Virginia	68	50	115,448	102,462	21,461	16,738
Other States	--	--	52,642	66,342	--	--
Total[1]	162	106	591,738	603,406	46,202	36,045

[1] Data may not add to totals shown because of independent rounding.

Table 38.—Bituminous coal and lignite loaded for shipment by railroads and waterways in the United States, in 1974, as reported by mine operators

(Thousand short tons)

Route	State	By State	Total for route
RAILROAD			
Alaska	Alaska	565	565
Atchison, Topeka & Santa Fe	Colorado	5	1,521
	New Mexico	1,516	
Baltimore & Ohio	Illinois	491	24,567
	Kentucky	16	
	Maryland	237	
	Ohio	7,251	
	Pennsylvania	4,053	
	West Virginia	12,519	
Bevier & Southern	Missouri	811	811
Bessemer & Lake Erie	Pennsylvania	2,576	2,576
Black Mesa & Salt River	Arizona	2,515	2,515
Burlington Northern	Illinois	7,488	29,659
	Iowa	36	
	Missouri	179	
	Montana (bituminous and lignite)	14,084	
	North Dakota (bituminous and lignite)	3,088	
	Wyoming	4,839	
Cambria & Indiana	Pennsylvania	3,745	3,745
Carbon County	Utah	678	678
Chesapeake & Ohio	Kentucky	25,189	53,542
	Ohio	180	
	West Virginia	28,273	
Chicago & Illinois Midland	Illinois	995	995
Chicago, Milwaukee, St. Paul and Pacific	Indiana	2,928	3,094
	North Dakota (lignite)	166	
Chicago & North Western	Illinois	3,244	3,244
Chicago, Rock Island & Pacific	Illinois	817	884
	Iowa	67	
Clinchfield	Kentucky	304	5,051
	Virginia	4,747	
Colorado & Wyoming	Colorado	540	540
Denver & Rio Grande Western	Colorado	5,251	7,170
	Utah	1,919	
Empire	Alabama	210	210
Erie-Lackawanna	Ohio	102	102
Illinois Central Gulf	Illinois	18,214	30,264
	Kentucky	12,050	
Kansas City Southern	Oklahoma	242	242
Kentucky & Tennessee	Kentucky	588	588
Lake Erie, Franklin & Clarion	Pennsylvania	125	125
Louisville & Nashville	Alabama	3,641	55,064
	Indiana	2,855	
	Kentucky	47,623	
	Tennessee	814	
	Virginia	131	
Mary Lee	Alabama	655	655
Missouri-Kansas-Texas	Kansas	134	673
	Missouri	537	
	Oklahoma	2	
Missouri Pacific	Arkansas	262	12,176
	Illinois	11,812	
	Kansas	4	
	Missouri	6	
	Oklahoma	92	
Monongahela	West Virginia	6,851	6,851
Montour	Pennsylvania	2,287	2,287
Norfolk & Western	Iowa	47	61,077
	Kentucky	14,691	
	Ohio	4,590	
	Virginia	17,788	
	West Virginia	24,011	
Penn Central (includes coal shipped over Kanawha & Michigan, Kelley's Creek, Toledo & Ohio Central and Zanesville & Western)	Illinois	2,886	41,465
	Indiana	6,615	
	Ohio	8,941	
	Pennsylvania	18,982	
	West Virginia	4,091	
Pittsburgh & Shawmut	Pennsylvania	2,360	2,360

See footnotes at end of table.

Table 38.—Bituminous coal and lignite loaded for shipment by railroads and waterways in the United States, in 1974, as reported by mine operators—Continued

(Thousand short tons)

Route	State	By State	Total for route
RAILROAD—Continued			
St. Louis-San Francisco	Alabama	242	2,205
	Arkansas	12	
	Kansas	242	
	Missouri	100	
	Oklahoma	1,609	
Soo Line	North Dakota (lignite)	380	380
Southern	Alabama	3,364	18,019
	Indiana	434	
	Kentucky	2,552	
	Tennessee	3,859	
	Virginia	7,810	
Squaw Creek	Indiana	397	397
Tennessee Coal, Iron & Railroad Co.	Alabama	1,451	1,451
Union Pacific	Colorado	116	9,796
	Wyoming	9,680	
Utah	Utah	1,326	1,326
Western Maryland	Maryland	1,302	5,434
	Pennsylvania	1,378	
	West Virginia	2,754	
Woodward Iron Company	Alabama	695	695
Yankeetown	Indiana	2,206	2,206
Total railroad shipments [1]		397,161	397,161
WATERWAY			
Allegheny River	Pennsylvania	620	620
Arkansas River	Arkansas	164	342
	Oklahoma	178	
Big Sandy River	Kentucky	204	204
Black Warrior River	Alabama	3,058	3,058
Green River	Kentucky	13,052	13,052
Illinois River	Illinois	26	26
Kanawha River	West Virginia	3,740	3,740
Monongahela River	Maryland	81	22,540
	Pennsylvania	15,323	
	West Virginia	7,136	
Ohio River	Illinois	1,856	22,228
	Indiana	3,453	
	Kentucky	7,380	
	Ohio	6,024	
	Pennsylvania	122	
	West Virginia	3,393	
Rough River	Kentucky	513	513
Tennessee River	Alabama	852	1,438
	Tennessee	586	
Total waterway shipments [1]		67,754	67,754
Total loaded at mine for shipment by railroads and waterways		464,915	464,915
Shipped by truck from mine to final destination		66,382	66,382
Coal transported to electric utility plants adjacent to or near the mine		66,635	66,635
All other [2]		5,474	5,474
Total production [1]		603,406	603,406

[1] Data may not add to totals shown because of independent rounding.

[2] Includes coal used at mine for power and heat, made into beehive coke at mine, used by mine employees, used for all other purposes at mine, and shipped by slurry pipeline.

Table 39.—Bituminous coal and lignite shipped by unit train in the United States
(Thousand short tons)

State	1973	1974
Alabama	8,930	8,276
Colorado	2,391	2,080
Illinois	22,155	24,262
Indiana	5,493	9,321
Kansas	190	164
Kentucky:		
Eastern	12,197	16,457
Western	7,291	8,101
Total[1]	19,489	24,558
Maryland	122	559
Missouri	--	100
Montana (bituminous)	10,115	12,475
New Mexico	778	704
North Dakota (lignite)	1,607	1,687
Ohio	18,266	16,528
Oklahoma	489	921
Pennsylvania	22,262	16,888
Tennessee	1,208	1,184
Utah	2,094	2,238
Virginia	4,477	4,278
West Virginia	34,203	23,103
Wyoming	5,826	10,379
Total[1]	155,098	154,645

[1] Data may not add to totals shown because of independent rounding.

Table 40.—Consumption of bituminous coal and lignite, by consumer class, and retail deliveries in the United States

(Thousand short tons)

Year and month	Electric power utilities[1]	Bunker, lake vessel and foreign[2]	Manufacturing and mining industries				Retail deliveries to other consumers[5]	Total of classes shown[6]
			Beehive coke plants	Oven coke plants	Steel and rolling mills[3]	Other manufacturing and mining industries[4]		
1970	318,921	298	1,428	94,581	5,410	82,909	12,072	515,619
1971	326,280	207	1,278	81,531	5,560	68,655	11,351	494,862
1972	348,612	163	1,059	86,218	4,850	67,131	8,748	516,776
1973:								
January	34,175	--	102	7,718	656	6,029	1,158	49,838
February	30,425	--	99	7,083	577	5,540	928	44,652
March	30,533	2	103	7,847	540	5,106	683	44,814
April	28,868	13	102	7,625	525	5,160	396	42,689
May	29,655	17	106	7,943	550	4,997	360	43,628
June	31,824	15	96	7,678	558	4,563	381	45,115
July	34,620	13	101	7,863	450	4,237	431	47,715
August	35,933	14	113	7,781	425	4,128	446	48,840
September	32,735	12	105	7,498	430	4,019	672	45,471
October	32,263	12	132	7,755	410	5,051	804	46,427
November	31,962	11	124	7,612	575	5,487	932	46,703
December	33,886	7	127	7,921	660	6,520	1,009	50,130
Total	386,879	116	1,310	92,324	6,356	60,837	8,200	556,022
1974:								
January	34,399	--	107	7,870	530	5,830	1,310	50,046
February	30,377	--	102	7,205	605	5,540	1,100	44,929
March	31,460	3	107	7,553	635	5,260	840	45,858
April	29,690	10	111	7,659	725	4,880	520	43,595
May	31,539	8	108	7,796	660	4,420	420	44,951
June	31,582	6	106	7,576	525	4,130	390	44,315
July	35,968	7	99	7,671	460	4,020	380	48,605
August	35,430	9	128	7,588	420	4,464	540	48,579
September	30,756	9	132	7,402	440	4,345	760	43,844
October	31,904	8	139	7,572	425	5,010	810	45,868
November	32,002	15	99	6,482	380	4,800	820	44,598
December	34,961	5	99	6,036	350	5,120	950	47,521
Total	390,068	80	1,337	88,410	6,155	57,819	8,840	552,709

[1] Federal Power Commission.

[2] Bureau of the Census, U.S. Department of Commerce; Ore and Coal Exchange.

[3] Estimates based upon reports collected from a selected list of representative steel and rolling mills.

[4] Estimates based upon reports collected from a selected list of representative manufacturing plants.

[5] Estimates based upon reports collected from a selected list of representative retailers. Includes some coal shipped by truck from mine to final destination.

[6] The total of classes shown approximates total consumption. The calculation of consumption from production, imports, exports, and changes in stocks is not as accurate as the "Total of classes shown" because certain significant items of stocks are not included in monthly stocks. These items are stocks on lake and tidewater docks, stocks at other intermediate storage piles between mine and consumer, and coal in transit.

Table 41.—Stocks and days' supply of bituminous coal and lignite in the United States, in 1974, by consumer class

(Thousand short tons)

Date	Electric power utilities [1]	Oven coke plants	Steel and rolling mills	Other manufacturing and mining industries	Retail dealers	Total
			STOCKS			
Jan. 31	81,927	6,269	400	8,940	300	97,836
Feb. 28	79,768	6,104	430	9,120	390	95,812
Mar. 31	84,923	6,255	530	9,430	430	101,568
Apr. 30	90,095	6,662	475	9,525	410	107,167
May 31	95,184	7,508	490	9,280	420	112,882
June 30	95,430	7,395	420	8,300	390	111,935
July 31	90,449	6,506	395	8,400	410	106,160
Aug. 31	88,468	6,720	440	9,400	450	105,478
Sept. 30	91,528	7,115	510	9,500	520	109,173
Oct. 31	99,422	8,348	560	9,830	510	118,670
Nov. 30	93,272	7,246	420	7,910	344	109,192
Dec. 31	82,631	6,037	360	6,220	280	95,528
			DAYS' SUPPLY [2]			
Jan. 31	74	25	23	48	7	61
Feb. 28	74	24	20	46	10	60
Mar. 31	84	26	26	56	16	69
Apr. 30	91	26	20	59	24	74
May 31	94	30	23	65	31	78
June 30	91	29	24	60	30	76
July 31	78	26	27	65	38	68
Aug. 31	77	27	33	65	26	67
Sept. 30	89	29	35	66	21	75
Oct. 31	97	34	41	61	20	80
Nov. 30	87	34	33	49	13	73
Dec. 31	73	31	32	38	9	62

[1] Federal Power Commission.

[2] Days' supply is calculated by dividing the total stocks at the end of the month by the daily average rate of consumption during the same month. By this method, seasonal variations in daily average rate of consumption is not reflected.

Table 42.—Distribution of bituminous coal and lignite, in 1974, by method of movement and consumer use

(Thousand short tons)

Shipments	Electric utilities	Coke and gas plants	Retail dealers	All others	Railroad fuel	Used at mines and sales to employees
Total shipments to all destinations in the United States, Canada, and Mexico, by all methods of movement and consumer use, and overseas exports	[1] 392,551	93,158	6,792	68,793	260	1,701
Shipments to all destinations in the United States, Canada, and Mexico by specific method of movement and consumer use:						
Method of movement:						
All-rail	[1] 205,601	58,397	3,876	35,857	--	--
River and ex-river	74,579	22,825	145	4,968	--	--
Great Lakes [2]	16,490	10,927	595	4,642	--	--
Tidewater [3]	2,465	3,701	--	98	--	--
Truck	50,859	2,229	2,176	16,233	--	--
Tramway, conveyor, and private railroad	42,557	79	--	2,000	--	--
Method of movement and/or consumer uses unknown	--	--	--	--	260	1,701
Total	[1] 392,551	98,158	6,792	63,793	260	1,701

Shipments	Canadian Great Lakes commercial docks [4]	U.S. Great Lakes dock storage [4]	U.S. tidewater dock storage [4]	Overseas exports [5]	Net change in mine inventory	Total
Total shipments to all destinations in the United States, Canada, and Mexico, by all methods of movement and consumer use, and overseas exports	83	228	--	45,809	—896	589,788
Shipments to all destinations in the United States, Canada, and Mexico by specific method of movement and consumer use:						
Method of movement:						
All-rail	--	--	--	--	--	[1] 298,731
River and ex-river	--	--	--	--	--	102,517
Great Lakes [2]	--	--	--	--	--	32,654
Tidewater [3]	--	--	--	--	--	6,259
Truck	--	--	--	--	--	71,497
Tramway, conveyor, and private railroad	--	--	--	--	--	44,686
Method of movement and/or consumer uses unknown	88	228	--	45,809	—896	47,185
Total	83	228	--	45,809	—896	[1] 603,479

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[1] Revised from the original figure published in Mineral Industry Survey "Bituminous Coal and Lignite Distribution, Calendar Year 1974".

[2] Excludes shipments to Canadian Great Lakes commercial docks and U.S. dock storage for which consumer uses are not available; however, includes vessel fuel, the destinations of which are not available.

[3] Excludes overseas exports for which consumer uses are not available.

[4] Consumer use unknown.

[5] Excludes Canada; consumer use unknown.

Table 43.—Distribution of bituminous coal and lignite, in 1974, by district of origin and consumer use

(Thousand short tons)

District of origin [1]	Electric utilities	Coke and gas plants	Retail dealers	All other	Railroad fuel	Used at mines and sales to employees
1	35,865	5,797	183	4,065	65	239
2	11,326	20,229	211	3,503	--	22
3 and 6	31,540	2,164	195	3,473	19	9
4	37,489	--	957	7,256	17	22
7	1,086	12,503	207	995	36	1,047
8	70,302	36,709	3,297	20,941	113	97
9	49,059	--	174	3,189	2	--
10	46,856	4,652	482	7,113	3	48
11	20,185	--	156	3,600	--	1
12	561	--	2	34	--	--
13	11,610	5,278	41	2,143	--	--
14	1	243	--	311	--	--
15	12,344	154	17	2,522	--	--
16	290	--	--	7	--	--
17	3,298	3,505	83	729	--	9
18	14,660	--	--	14	--	--
19	[2] 19,291	79	91	1,324	--	6
20	2,374	1,845	443	1,272	4	24
21	6,397	--	114	724	--	177
22 and 23	18,017	--	139	578	1	--
Total	[2] 392,551	93,158	6,792	63,793	260	1,701

District of origin [1]	Canadian Great Lakes commercial docks [3]	U.S. Great Lakes dock storage [3]	U.S. tidewater dock storage [3]	Overseas exports [4]	Net change in mine inventory	Total
1	--	3	--	4,425	—194	50,448
2	5	12	--	77	7	35,392
3 and 6	35	—6	--	2,906	—126	40,209
4	19	--	--	--	—476	45,284
7	1	4	--	12,868	37	28,784
8	28	215	--	23,812	8	155,517
9	--	--	--	--	—44	52,380
10	--	--	--	--	—69	59,085
11	--	--	--	--	—31	23,911
12	--	--	--	--	--	597
13	--	--	--	1,856	41	20,469
14	--	--	--	187	--	742
15	--	--	--	--	—56	14,981
16	--	--	--	--	3	300
17	--	--	--	19	33	7,676
18	--	--	--	--	23	14,697
19	--	--	--	9	—1	[2] 20,799
20	--	--	--	138	—14	6,086
21	--	--	--	12	5	7,429
22 and 23	--	--	--	--	—42	18,693
Total	88	228	--	45,809	—896	[2] 603,479

[1] Producing districts are defined in Bureau of Mines Bituminous Coal and Lignite Distribution Calendar Year 1974, Mineral Industry Survey, April 18, 1975, 53 pp.

[2] Revised from the original figure published in Mineral Industry Survey "Bituminous Coal and Lignite Distribution, Calendar Year 1974."

[3] Consumer use unknown.

[4] Excludes Canada; consumer use unknown.

Table 44.—Distribution of bituminous coal and lignite, in 1974, by destination and consumer use

(Thousand short tons)

Destination	Total	Electric utilities	Coke and gas plants	Retail dealers	All other [1]
New England:					
Massachusetts	749	652	--	22	75
Connecticut	214	153	--	1	60
Maine	57	--	--	6	51
New Hampshire	911	902	--	--	9
Vermont	52	48	--	--	4
Rhode Island	72	72	--	--	--

See footnotes at end of table.

Table 44.—Distribution of bituminous coal and lignite, in 1974, by destination and consumer use—Continued

(Thousand short tons)

Destination	Total	Electric utilities	Coke and gas plants	Retail dealers	All other[1]
Middle Atlantic:					
New York	14,742	7,088	5,524	72	2,058
New Jersey	3,058	2,918	--	7	133
Pennsylvania	63,322	34,411	22,991	284	5,636
East North Central:					
Ohio	69,642	44,171	13,087	1,130	11,254
Indiana	43,921	25,313	13,609	396	4,603
Illinois	39,054	30,837	3,100	772	4,345
Michigan	29,250	20,623	3,835	351	4,441
Wisconsin	12,335	9,436	240	367	2,292
West North Central:					
Minnesota	9,668	7,728	726	237	977
Iowa	6,589	5,230	--	84	1,275
Missouri	17,844	15,840	289	159	1,556
North Dakota	5,812	5,368	--	126	318
South Dakota	442	411	--	27	4
Nebraska	1,786	1,465	--	10	311
Kansas	1,825	1,683	--	3	139
South Atlantic:					
Delaware	795	773	--	--	22
Maryland	8,896	4,498	3,669	30	699
District of Columbia	496	306	--	26	164
Virginia	7,410	4,579	--	505	2,326
West Virginia	33,784	24,028	5,107	327	4,322
North Carolina	21,337	19,552	--	296	1,489
South Carolina	8,061	6,557	--	184	1,320
Georgia	10,766	10,425	--	43	298
Florida	6,259	6,259	--	--	--
East South Central:					
Kentucky	25,445	21,710	1,397	267	2,071
Tennessee	18,916	16,367	169	253	2,127
Alabama	25,125	16,097	6,663	27	2,338
Mississippi	1,594	1,546	--	--	48
West South Central:					
Arkansas	112	--	--	--	112
Louisiana	--	--	--	--	--
Oklahoma	175	--	--	3	172
Texas	8,607	5,426	878	1	2,302
Mountain:					
Colorado	7,290	5,618	1,109	75	488
Utah	4,252	1,467	1,911	263	611
Montana	907	843	--	9	55
Idaho	472	--	--	137	335
Wyoming	[2]6,731	[2]6,233	--	24	474
New Mexico	7,686	7,679	--	--	7
Arizona	3,059	3,048	--	--	11
Nevada	4,575	4,448	--	2	125
Pacific:					
Washington	4,167	3,890	--	10	267
Oregon	149	--	--	9	140
California	2,184	--	2,148	1	35
Alaska	690	262	--	12	416
Canada[3]	13,619	6,507	6,198	196	718
Mexico	411	--	339	--	72
Destinations not revealable	408	89	169	38	112
Destinations and/or consumer uses not available:					
Great Lakes movement:					
Canadian commercial docks	88	--	--	--	--
Vessel fuel	571	--	--	--	--
U.S. dock storage	228	--	--	--	--
Tidewater movement:					
Overseas exports (except Canada)	45,809	--	--	--	--
Bunker fuel	--	--	--	--	--
U.S. dock storage	--	--	--	--	--
Railroad fuel:					
U.S. companies	256	--	--	--	--
Canadian companies	4	--	--	--	--
Coal used at mines and sales to employees	1,701	--	--	--	--
Net change in mine inventory	—896	--	--	--	--
Total	[2]603,479	--	--	--	--

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[1] Excludes vessel fuel and bunker fuel, the destinations of which are not available.

[2] Revised from the original figure published in Mineral Industry Survey "Bituminous Coal and Lignite Distribution, Calendar Year 1974."

[3] Excludes shipments to Canadian Great Lakes commercial docks and Canadian railroad companies.

Table 45.—Total bituminous coal and lignite shipments and percent of grand total shipments, by geographic division and State of destination

Geographic division and State of destination	Thousand short tons					Percent of total				
	1970	1971	1972	1973	1974	1970	1971	1972	1973	1974
Total	597,992	553,123	595,214	589,788	[1]603,479	100.0	100.0	100.0	100.0	100.0
New England	3,568	2,445	1,522	1,333	2,055	.6	.4	.2	.2	.3
Massachusetts	608	227	147	106	749	.1	(2)	(2)	(2)	.1
Connecticut	1,832	1,271	109	118	214	.3	.2	(2)	(2)	(2)
Maine, New Hampshire, Vermont, and Rhode Island	1,128	947	1,266	1,109	1,092	.2	.2	.2	.2	.2
Middle Atlantic	90,992	77,552	78,998	80,283	81,122	15.2	14.0	13.2	13.6	13.4
New York	23,032	15,596	13,177	13,290	14,742	3.9	2.8	2.2	2.3	2.4
New Jersey	4,951	2,974	1,303	2,524	3,058	.8	.5	.2	.4	.5
Pennsylvania	63,009	58,982	64,518	64,469	63,322	10.5	10.7	10.8	10.9	10.5
East North Central	206,011	187,969	206,504	195,565	194,202	34.5	34.0	34.7	33.2	32.2
Ohio	67,375	63,116	67,795	65,557	69,642	11.3	11.4	11.4	11.1	11.5
Indiana	42,385	38,599	46,618	45,061	43,921	7.1	7.0	7.8	7.6	7.3
Illinois	42,310	38,289	42,028	40,628	39,054	7.1	6.9	7.1	6.9	6.5
Michigan	36,633	32,625	35,085	31,685	29,250	6.1	5.9	5.9	5.4	4.9
Wisconsin	17,308	15,340	14,978	12,634	12,335	2.9	2.8	2.5	2.2	2.0
West North Central	35,098	35,407	39,587	42,778	43,966	5.9	6.4	6.7	7.3	7.3
Minnesota	8,769	8,313	8,639	9,161	9,668	1.5	1.5	1.4	1.6	1.6
Iowa	6,159	6,239	6,956	6,889	6,589	1.0	1.1	1.2	1.2	1.1
Missouri	13,397	13,358	15,810	17,385	17,844	2.3	2.4	2.7	2.9	3.0
North Dakota and South Dakota	4,799	5,272	5,834	5,816	6,254	.8	1.0	1.0	1.0	1.0
Nebraska and Kansas	1,974	2,225	2,348	3,527	3,611	.3	.4	.4	.6	.6
South Atlantic	91,559	90,354	96,907	95,072	97,804	15.3	16.3	16.3	16.1	16.2
Delaware and Maryland	13,928	11,599	9,744	10,596	9,691	2.3	2.1	1.6	1.8	1.6
District of Columbia	1,113	598	458	548	496	.2	.1	.1	.1	.1
Virginia	11,065	9,258	8,027	7,910	7,410	1.9	1.7	1.3	1.3	1.2
West Virginia	24,395	26,606	32,459	32,305	33,784	4.1	4.8	5.5	5.5	5.6
North Carolina	21,696	19,779	21,489	19,820	21,337	3.6	3.6	3.6	3.3	3.5
South Carolina	6,143	6,219	6,915	6,999	8,061	1.0	1.1	1.2	1.2	1.4
Georgia and Florida	13,219	16,295	17,815	16,894	17,025	2.2	2.9	3.0	2.9	2.8
East South Central	69,185	72,191	78,843	75,011	71,080	11.6	13.0	13.2	12.7	11.8
Kentucky	23,672	25,590	27,389	25,078	25,445	4.0	4.6	4.6	4.2	4.2
Tennessee	18,315	18,907	21,390	22,238	18,916	3.1	3.4	3.6	3.8	3.2
Alabama and Mississippi	27,198	27,694	30,064	27,695	26,719	4.5	5.0	5.0	4.7	4.4
West South Central: Arkansas, Louisiana, Oklahoma, and Texas	1,144	887	980	8,049	8,894	.2	.2	.2	1.4	1.5
Mountain	20,232	21,581	26,330	29,836	[1]34,972	3.4	3.9	4.4	5.1	5.8
Colorado	5,136	4,475	5,516	6,490	7,290	.9	.8	.9	1.1	1.2
Utah	3,010	2,998	3,017	3,957	4,252	.5	.5	.5	.7	.7
Montana and Idaho	1,065	1,348	1,281	1,395	1,380	.2	.3	.2	.2	.2
Wyoming	3,809	3,728	5,152	6,200	[1]6,731	.6	.7	.9	1.1	1.1
New Mexico	6,032	6,718	6,851	7,343	7,686	1.0	1.2	1.1	1.2	1.3
Arizona and Nevada	1,180	2,324	4,518	4,451	7,684	.2	.4	.8	.8	1.3
Pacific	2,691	3,329	4,645	5,908	6,500	.5	.6	.8	1.0	1.1
Washington and Oregon	874	1,482	2,865	3,510	4,316	.1	.3	.5	.6	.7
California	2,317	1,847	1,780	2,398	2,184	.4	.3	.3	.4	.4

See footnotes at end of table.

Table 45.—Total bituminous coal and lignite shipments and percent of grand total shipments, by geographic division and State of destination—Continued

Geographic division and State of destination	Thousand short tons					Percent of total				
	1970	1971	1972	1973	1974	1970	1971	1972	1973	1974
Alaska	612	748	707	707	690	.1	.1	.1	.1	.1
Canada [3]	18,673	17,522	18,162	16,231	13,706	3.1	3.2	3.1	2.7	2.3
Mexico	168	291	466	305	411	(2)	.1	.1	.1	.1
Destinations not revealable	[4] 2,969	[5] 2,179	[6] 1,702	[7] 1,755	408	[4] .5	[5] .4	[6] .3	[7] .3	.1
U.S. railroad fuel	721	528	357	224	256	.1	.1	.1	(2)	(2)
U.S. Great Lakes dock storage	−16	−263	−266	−117	228	(2)	(2)	(2)	(2)	(2)
U.S. tidewater dock storage	---	---	---	---	---	---	---	---	---	---
Vessel fuel	1,072	713	595	600	571	.2	.1	.1	.1	.1
Bunker fuel	---	---	---	---	---	---	---	---	---	---
Overseas exports	[8] 51,766	[9] 37,810	[10] 36,607	[11] 35,570	45,809	[8] 8.6	[9] 6.8	[10] 6.1	[11] 6.0	7.6
Coal used at mines and sales to employees	1,486	1,488	1,521	1,600	1,701	.2	.3	.2	.3	.2
Change in mine inventory	66	397	1,097	−922	−896	(2)	.1	.2	—.2	—.1

[1] Revised from the original figure published in Mineral Industry Survey "Bituminous Coal and Lignite Distribution, Calendar Year 1974."
[2] Less than 0.1%.
[3] Includes shipments to Canadian Great Lakes commercial docks and railroad companies.
[4] Includes overseas exports from producing districts 13 and 17.
[5] Includes overseas exports from producing districts 13, 14, 17, and 20.
[6] Includes overseas exports from producing districts 13, 14, and 20.
[7] Includes overseas exports from producing districts 13 and 14.
[8] Excludes overseas exports from producing districts 13 and 17.
[9] Excludes overseas exports from producing districts 13, 14, 17, and 20.
[10] Excludes overseas exports from producing districts 13, 14, and 20.
[11] Excludes overseas exports from producing districts 13 and 14.

Table 46.—Exports of bituminous coal, by country group
(Thousand short tons and thousand dollars)

Country group	1972		1973		1974	
	Quantity	Value	Quantity	Value	Quantity	Value
Canada (including Newfoundland and Mexico)	18,627	264,575	r 16,536	253,011	14,117	356,384
Overseas (all other countries):						
West Indies and Central America	--	--	(1)	1	(1)	13
Bermuda, Greenland, Miquelon, St. Pierre Islands	1	17	2	32	--	--
South America	2,651	51,497	2,654	54,154	2,350	97,285
Europe	16,679	307,647	14,253	290,327	15,856	633,601
Asia	18,039	349,453	19,381	403,954	27,603	1,333,050
Africa	--	--	(1)	5	(1)	(1)
Oceania	(1)	(1)	44	973	(1)	1
Total	37,370	708,614	36,334	749,446	45,809	2,063,950
Grand total	55,997	973,189	r 52,870	1,002,457	59,926	2,420,334

r Revised.

[1] Less than ½ unit.

Table 47.—Bituminous coal exported from the United States by country[1]
(Thousand short tons and thousand dollars)

Country	1972		1973		1974	
	Quantity	Value	Quantity	Value	Quantity	Value
Australia	--	--	44	973	(2)	(2)
Argentina	394	7,655	772	15,400	630	28,796
Belgium-Luxembourg	1,144	22,214	1,205	25,461	1,109	48,259
Brazil	1,917	37,067	1,645	33,482	1,292	53,580
Canada	18,161	254,243	16,231	246,247	13,706	343,398
Chile	240	5,315	194	4,481	312	11,532
France	1,575	30,632	1,866	39,882	2,510	106,990
Germany:						
East	19	411	--	--	--	--
West	2,399	39,780	1,633	30,589	1,484	60,187
Greece	--	--	33	646	41	950
Ireland	22	416	--	--	--	--
Israel	--	--	--	--	11	422
Italy	3,673	69,584	3,294	64,543	3,903	151,446
Japan	18,038	349,444	19,190	399,573	27,346	1,320,155
Korea, Republic of	--	--	191	4,377	246	12,464
Mexico	466	10,332	r 305	6,764	411	12,986
Netherlands	2,289	39,925	1,780	36,111	2,545	95,355
Norway	167	3,361	126	2,757	145	6,904
Peru	67	792	22	380	85	2,236
Portugal	304	5,813	395	8,267	334	14,347
Romania	--	--	284	5,879	163	5,528
Spain	2,139	42,928	2,234	47,252	2,017	87,768
Sweden	425	8,260	342	6,815	200	6,181
United Kingdom	2,381	41,798	941	19,932	1,405	49,736
Uruguay	32	653	21	406	31	1,137
Yugoslavia	142	2,530	120	2,193	--	--
Other	3	41	2	47	(2)	27
Total	55,997	973,189	r 52,870	1,002,457	59,926	2,420,334

r Revised.

[1] Amounts stated do not include fuel or bunker coal on vessels engaged in foreign trade, which aggregated 30,718 tons ($545,146) in 1972, 11,898 tons ($231,789) in 1973, and 3,351 tons ($70,799) in 1974.

[2] Less than ½ unit.

Table 48.—Bituminous coal exported from the United States, by customs district

(Thousand short tons and thousand dollars)

Customs district	1972		1973		1974	
	Quantity	Value	Quantity	Value	Quantity	Value
Baltimore	3,751	66,061	4,402	85,646	5,949	255,528
Buffalo	13	183	13	226	36	923
Charleston	--	--	--	--	(1)	(1)
Chicago	65	759	81	974	38	582
Cleveland	17,802	248,305	15,933	240,980	13,240	327,064
Detroit	94	1,676	106	1,888	136	4,660
Duluth	9	175	7	119	(1)	25
El Paso	42	721	22	401	24	500
Houston	1	9	--	--	(1)	3
Laredo	424	9,611	r 282	6,354	386	12,461
Los Angeles	174	3,826	(1)	3	115	4,174
Mobile	1,142	17,384	1,123	19,277	1,746	52,578
New Orleans	774	12,300	658	11,734	992	27,341
New York City	(1)	7	1	6	1	20
Nogales	--	--	(1)	9	--	--
Norfolk	31,585	609,936	30,192	633,815	35,745	1,648,712
Ogdensburg	50	778	23	460	24	650
Pembina	13	256	8	157	18	701
Philadelphia	(1)	2	22	377	1,431	33,461
Port Arthur	57	1,180	--	--	27	564
Portland, Maine	--	--	--	--	4	73
Portland, Oreg	--	--	(1)	1	13	253
San Diego	(1)	3	(1)	1	1	25
San Francisco	(1)	2	(1)	3	(1)	6
San Juan	--	--	(1)	1	(1)	5
Seattle	1	15	2	25	(1)	25
Total	55,997	973,189	r 52,870	1,002,457	59,926	2,420,334

r Revised.

[1] Less than ½ unit.

Table 49.—Bituminous coal[1] imported for consumption in the United States, by country and customs district

Country and customs district	1972		1973		1974	
	Quantity (short tons)	Value (thousands)	Quantity (short tons)	Value (thousands)	Quantity (short tons)	Value (thousands)
Country:						
Australia	1,120	$49	--	--	143,633	$2,566
Belgium-Luxembourg	--	--	--	--	1,135	60
Brazil	--	--	--	--	18	(²)
Canada	44,821	621	113,884	$1,491	595,587	11,305
France	--	--	--	--	764	94
Germany, West	--	--	59	1	513,219	24,432
Japan	20	2	--	--	--	--
Netherlands	--	--	--	--	171,185	7,817
Norway	--	--	--	--	1,654	139
Panama	--	--	--	--	1,128	15
Poland	--	--	12,698	115	468,344	7,040
South Africa, Republic of	1,127	18	--	--	172,223	3,236
United Kingdom	10	1	--	--	11,517	1,027
Total	47,098	691	126,641	1,607	2,080,407	57,731
Customs district:						
Baltimore	--	--	--	--	622,824	17,659
Boston	--	--	12,698	115	666,954	11,000
Buffalo	--	--	437	8	1,005	47
Chicago	--	--	403	6	151	3
Cleveland	--	--	--	--	1,381	62
Detroit	--	--	73,152	897	101,866	1,597
Duluth	16,393	246	25,076	377	41,705	823
Great Falls	7,492	61	2,143	13	10,983	340
Honolulu	20	2	--	--	--	--
Houston	1,120	49	--	--	--	--
Mobile	--	--	--	--	117,246	1,842
New Orleans	1,127	18	--	--	13,189	1,166
New York City	10	1	--	--	--	--
Norfolk	--	--	12,521	188	--	--
Ogdensburg	--	--	144	2	--	--
Pembina	20,921	313	59	1	29,380	634
Philadelphia	--	--	--	--	470,521	22,495
Portland, Maine	15	1	8	(²)	3,202	63
San Francisco	(²)	(²)	--	--	--	--
Total	47,098	691	126,641	1,607	2,080,407	57,731

[1] Includes slack, culm, and lignite.

[2] Less than ½ unit.

Table 50.—Bituminous coal and lignite coal: World production, by country

(Thousand short tons)

Country [1]	1972	1973	1974 [p]
North America:			
Canada:			
Bituminous	17,427	18,540	19,800
Lignite	3,283	4,028	3,800
Greenland: Bituminous	4	(2)	--
Mexico: Bituminous	[r] 3,598	4,699	5,695
United States:			
Bituminous	584,387	577,574	587,928
Lignite	10,999	14,164	15,478
South America:			
Argentina: Bituminous	[r] 765	499	690
Brazil: Bituminous (marketable)	[r] 2,722	2,531	2,200
Chile: Bituminous (marketable)	1,472	1,426	1,554
Colombia: Bituminous [e]	3,500	3,600	3,900
Peru: Bituminous [e]	83	83	88
Venezuela: Bituminous	44	55	68
Europe:			
Albania: Lignite [3]	[e] 843	894	[e] 987
Austria: Lignite [4]	4,139	4,006	4,000
Belgium: Bituminous	8,816	6,988	6,694
Bulgaria:			
Bituminous	252	246	[e] 212
Lignite [3]	[r] 29,644	29,166	26,448
Czechoslovakia:			
Bituminous	[r] 30,782	30,625	30,767
Lignite [3]	[r] 93,620	89,562	90,561
France:			
Bituminous	23,455	20,492	18,652
Lignite	[r] 3,265	3,047	3,042
Germany, East:			
Bituminous	898	830	[e] 660
Lignite [3]	273,870	271,438	268,368
Germany, West:			
Bituminous	[r] 104,161	99,843	96,966
Lignite	121,712	130,798	138,938
Greece: Lignite	[r] 12,259	14,460	15,356
Hungary:			
Bituminous	3,309	3,165	3,587
Lignite [3]	24,439	25,762	24,860
Ireland: Bituminous [e]	58	58	66
Italy:			
Bituminous	166	6	--
Lignite	[r] 1,539	2,371	1,296
Poland:			
Bituminous	166,115	172,655	178,579
Lignite [3]	42,131	43,227	43,900
Romania:			
Bituminous [5]	7,288	7,906	7,834
Lignite [3]	[r] 18,958	20,249	21,818
Spain:			
Bituminous	8,820	7,690	8,065
Lignite	[r] 3,359	3,306	3,197
Svalbard (Spitzbergen): Bituminous [6]	502	457	481
U.S.S.R.: [7]			
Bituminous	[r] 467,437	478,610	484,548
Lignite [3]	171,651	173,019	176,346
United Kingdom: Bituminous	[r] 134,261	145,505	[e] 117,000
Yugoslavia:			
Bituminous	660	635	665
Lignite [3]	33,446	35,135	36,369
Africa:			
Algeria: Bituminous [8]	13	14	[e] 15
Mozambique: Bituminous	370	434	470
Nigeria: Bituminous	376	360	[e] 385
Rhodesia, Southern: Bituminous [9]	3,045	3,373	[e] 3,400
South Africa, Republic of: Bituminous (marketable)	62,946	67,179	70,319
Swaziland: Bituminous	139	154	128
Tanzania: Bituminous	3	2	2
Zaire: Bituminous	141	127	114
Zambia: Bituminous	1,033	1,036	892
Asia:			
Afghanistan: Bituminous [10]	[e] 150	126	169
Burma: Bituminous	23	15	16
China, People's Republic of: Bituminous and lignite [e]	420,000	450,000	468,000

See footnotes at end of table.

Table 50.—Bituminous coal and lignite coal: World production, by country—Continued

(Thousand short tons)

Country [1]	1972	1973	1974 [p]
Asia—Continued			
India:			
Bituminous	82,421	84,878	91,779
Lignite	3,881	3,638	3,328
Indonesia: Bituminous	197	164	172
Iran: Bituminous	1,102	1,157	1,328
Japan:			
Bituminous	[r] 30,469	24,468	22,259
Lignite	[r] 112	95	83
Korea, North: Bituminous [e] [11]	7,400	7,700	8,700
Mongolia:			
Bituminous	117	130	[e] 140
Lignite	2,367	2,432	[e] 2,500
Pakistan: Bituminous and lignite [12]	1,379	1,280	1,213
Philippines: Bituminous	43	43	56
Taiwan: Bituminous	4,313	3,667	3,234
Thailand: Lignite	380	398	585
Turkey:			
Bituminous	5,116	5,118	5,645
Lignite	5,151	5,296	[e] 5,600
Oceania:			
Australia:			
Bituminous	[r] 65,796	66,867	70,116
Lignite	26,121	27,201	31,135
New Zealand:			
Bituminous	2,237	2,562	2,669
Lignite	168	160	159
World total:			
Bituminous	[r] 1,837,932	1,854,292	1,858,647
Lignite	[r] 886,837	903,852	918,099
Mixed grades [13]	421,379	451,280	469,213
Total, all grades	[r] 3,146,148	3,209,424	3,245,959

[e] Estimate. [p] Preliminary. [r] Revised.

[1] In addition to the countries listed, Ecuador produces coal, but output was less than 500 tons annually in the years covered by this table.

[2] Revised to zero.

[3] Includes material reported in national sources as brown coal.

[4] Available sources report only lignite production; a small amount of bituminous coal may also be produced.

[5] Official sources report the aggregate of bituminous coal and anthracite; distribution to these separate grades is estimated from reported total.

[6] Output from Norwegian-controlled portion only. Output of that portion of Svalbard controlled by the U.S.S.R. is presumably included in the total output recorded for that country.

[7] Run-of-mine output.

[8] May include small amount of anthracite.

[9] Sales for year ending August 31 of that stated.

[10] Year beginning March 21 of that stated.

[11] Data include low-ranked coals, including some lignite.

[12] Year ending June 30 of that stated.

[13] Bituminous coal plus lignite for the People's Republic of China plus Pakistan.

Table 51.—Energy consumed in bituminous coal and lignite production by type and State, 1974

State	Production (thousand short tons)	Electricity (purchased) (thousand kilowatt-hours)	Heavy fuel-oils (thousand gallons)	Diesel or light fuel (thousand gallons)	Gasoline (thousand gallons)	Other petroleum products (thousand gallons)	Natural gas (million cubic feet)	Coal (thousand short tons)
Alabama	18,720	351,294	557	21,751	1,990	266	123	1
Alaska	694	W	W	W	W	--	--	W
Arizona	3,570	28,680	--	1,071	108	--	--	--
Arkansas	434	5,859	W	1,389	295	W	W	--
Colorado	6,194	43,179	46	1,596	317	--	--	W
Illinois	61,694	828,083	36	16,129	2,482	(1)	--	18
Indiana	25,255	412,417	--	14,260	2,025	49	--	--
Iowa	601	1,531	W	414	337	--	--	--
Kansas	1,086	25,853	49	861	183	35	7	--
Kentucky	120,813	1,532,554	8,406	76,568	14,099	9,963	178	37
Maryland	1,793	2,889	169	3,788	364	7	--	--
Missouri	4,658	76,226	--	2,767	518	--	W	--
Montana:								
Bituminous	10,412	21,909	3	1,935	227	--	--	--
Lignite	313	(1)	--	(1)	(1)	--	--	--
Total Montana	10,725	21,909	3	1,935	227	--	--	--
New Mexico	9,069	46,541	114	2,431	344	105	42	(1)
North Dakota (lignite)	6,907	29,815	282	1,262	147	38	95	(1)
Ohio	47,003	232,036	2,215	37,365	4,564	210	5	118
Oklahoma	2,183	33,562	40	2,358	399	W	--	--
Pennsylvania	75,978	1,061,446	6,425	69,013	6,925	2,017	978	41
Tennessee	8,293	80,598	831	12,169	994	97	30	(1)
Texas	6,944	35,391	--	1,733	161	--	--	--
Utah	5,500	83,072	101	537	220	29	1	24
Virginia	36,550	829,281	1,100	13,904	3,806	47	W	56
Washington	3,270	5,448	--	2,768	329	--	--	--
West Virginia	110,661	2,267,947	7,391	47,249	7,623	6,149	1,369	323
Wyoming	14,886	73,518	179	3,817	560	346	--	W
Undistributed	--	9,634	25	1,272	138	22	39	4
Total [2]	583,481	8,118,768	27,969	338,407	49,105	19,380	2,867	622

W Withheld to avoid disclosing individual company confidential data.

[1] Less than ½ unit.

[2] Production reported 98.6% of total U.S. production of 603,406,000.

Table 52.—Shipments of bituminous coal and lignite by average sulfur content by consumer use, in 1974

District	Quantity shipped (thousand short tons)						Average sulfur content (percent)					
	Electric utilities	Coke and gas plants	Other industrial uses and retail dealers	All other uses	Exports (overseas and Canada)	Total [1]	Electric utilities	Coke and gas plants	Other industrial uses and retail dealers	All other uses	Exports (overseas and Canada)	Total [1]
Eastern Pennsylvania	26,898	4,407	2,900	1,394	2,337	37,936	2.2	1.0	1.9	2.4	1.7	2.0
Western Pennsylvania	6,876	16,133	1,239	2,090	549	26,887	2.1	1.5	2.1	1.7	2.5	1.7
Northern West Virginia	17,678	1,628	1,708	486	3,098	24,588	2.9	1.4	2.4	2.0	2.0	2.6
Ohio	33,930	--	5,439	655	--	40,024	3.6	--	3.2	3.1	--	3.5
Michigan	--	--	--	--	--	--	--	--	--	--	--	--
Panhandle	6,683	--	340	1	--	7,024	3.9	--	2.9	3.1	--	3.8
Southern Number 1	256	8,634	1,106	340	6,409	16,745	.6	.6	.8	.7	.7	.7
Southern Number 2	35,136	17,052	6,078	1,526	9,422	69,214	1.1	.8	.9	1.0	.9	1.0
West Kentucky	45,018	--	5,711	1	--	50,730	3.9	--	3.0	1.4	--	3.9
Illinois	46,737	3,171	6,820	1,199	--	57,927	3.2	.9	2.9	3.6	--	3.1
Indiana	19,581	--	3,879	18	--	23,478	3.5	--	3.3	3.6	--	3.4
Iowa	514	--	1	3	--	518	3.3	--	3.0	3.0	--	3.3
Southeastern	8,309	4,250	639	766	299	14,263	1.6	1.0	2.2	.7	1.4	1.4
Arkansas-Oklahoma	--	174	228	52	172	626	--	1.8	2.3	.9	.6	1.6
Southwestern	14,117	39	395	56	--	14,607	2.8	.5	2.0	2.8	--	2.8
Northern Colorado	285	--	8	15	--	308	.4	--	.4	.3	--	.4
Southern Colorado	3,507	2,877	430	48	--	6,862	.6	.6	.8	.4	--	.6
New Mexico	14,839	--	106	1	1	14,947	.6	--	.8	.8	.8	.6
Wyoming	18,780	80	1,228	244	--	20,332	.5	.9	.7	.8	--	.6
Utah	2,073	1,669	1,129	853	135	5,859	.6	.9	.6	.7	--	.7
North-South Dakota	6,302	--	578	380	--	7,260	.8	--	.7	.7	--	.8
Montana	13,587	--	485	22	13	14,107	.7	--	.8	.9	.7	.7
Washington	4,574	--	16	--	--	4,590	.5	--	.2	--	--	.5
Total United States	325,680	60,114	40,458	10,150	22,430	458,832	2.4	1.0	2.3	1.8	1.1	2.2

[1] Total shipments by producers reporting sulfur content (76% of total U.S. production).

Coal-Pennsylvania Anthracite

By Dorothy R. Federoff [1]

All of the reported production of anthracite in 1974 originated in northeastern Pennsylvania. The anthracite region is divided geologically into four fields: Eastern Middle, Northern, Southern, and Western Middle. The area is also grouped into three trade regions: Lehigh, Schuylkill, and Wyoming.

A combination of circumstances resulted in an overall demand for anthracite that exceeded supply. An increased world demand for steel, an oil embargo, and a nationwide bituminous coal strike combined to open additional markets for industrial anthracite in the steel industry. Anthracite consumption by the steel industry in the United States increased 16% over that of 1973.

Production of anthracite in 1974 totaled 6.6 million short tons, a decrease of 3% from that of 1973. The decline in production was accelerated by the liquidation of a major anthracite-producing company in the Wyoming region. Consequently, the output of sizes for domestic heating dropped about 50%, creating a serious shortage of coal for space heating throughout the northeastern area. Because of the energy crisis, the Federal Bureau of Mines established an office at Wilkes-Barre, Pa., to help consumers obtain coal during the emergency.

Of the total output, 45% was recovered from culm and silt banks, 43% was produced at strip pits, 10% came from underground mines, and 2% was recovered at dredging operations. When compared with tonnages produced in 1973, underground production declined 9%, strip production 13%, and dredge coal recovery 66%. However, recovery from culm and silt banks increased 23%, somewhat compensating for the drop in strip and underground production and raising the total to within 3% of the tonnage produced in 1973.

The contraction of the industry, combined with increased costs of materials, labor, and transportation, increased prices well above the 1973 levels.

Total value of the 1974 output was $144.7 million, a 60% increase over that of 1973. The average value f.o.b. preparation plants for all sizes of anthracite, including dredge coal, was $21.87 per ton, compared with $13.22 per ton in 1973. The average value of pea and larger sizes increased $11.65 per ton ($18.76 to $30.41), and the average value of buckwheat No. 1 and smaller sizes increased $7.63 per ton ($10.90 to $18.53).

Apparent consumption of Pennsylvania anthracite in the United States in 1974, calculated as production minus exports, excluding that exported to West Germany for use by the U.S. Armed Forces, totaled approximately 5.4 million tons, compared with 5.7 million tons in 1973, a decrease of 4%. Overall consumption was as follows: Space heating, 47%; electric utilities, 28%; coke making, 8%; sintering and pelletizing, 7%; colliery fuel, less than 1%; and other industrial uses, 10%.

According to the U.S. Bureau of the Census, exports in 1974 totaled approximately 735,173 short tons, an increase of 3% over the 716,546 tons shipped to foreign countries in 1973. Of that total, 65% was shipped to Canada, 27% was exported to Europe, and the remainder went to other countries. A more accurate measurement of exports can be obtained by adding the quantity shipped for use by the armed forces in West Germany to the tonnage reported by the Bureau of the

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[1] Mineral specialist, Division of Fuels Data.

Census. This computation indicated that 1,169,468 tons was actually exported, an increase of approximately 1% over that in 1973.

The Pennsylvania anthracite mining industry worked an average of 219 days in 1974, compared with 234 days in 1973. The suspension of operations by one of the major companies in the first half of 1974 and a drop in river dredging operations resulted in a reduced labor force. The work force averaged 3,847, an employee decline of approximately 6% from that of 1973. Of that total, 1,376 were employed at strip pits, 594 at underground mines, 390 at culm and silt recovery, 20 at dredging operations, and 1,467 at breakers and other surface operations.

Although there were declines in total production and in the number of men employed daily, the productivity rate in average tons per man-day increased from 7.15 tons in 1973 to 7.87 tons in 1974. The continued rise in the productivity rate was due to increased surface mining. Two fatalities occurred in 1974 (1 in 1973), and there were 262 nonfatal injuries (370 in 1973).

The Bureau of Mines publishes a series of weekly and monthly reports containing estimates of production derived primarily from factors based on carloading data furnished by the railroads and monthly truck shipments provided by the Commonwealth of Pennsylvania. The weekly and monthly estimates have been adjusted to the production total for 1974 and are presented on tables 13 and 14.

Legislation and Government Programs.—State and Federal Government programs in the environmental area continued throughout 1974, and included control and extinguishment of fires in abandoned underground and surface mines, prevention of surface subsidence above abandoned mines, reclamation of old strip pits and culm banks, and mine-water control projects designed to secure the safety of mine personnel and to protect anthracite reserves from the hazards of adjoining abandoned mine pools and possible inundation by surface flood waters.

Hydrologic studies were continued to evaluate mine-water problems. These involved determination of the varying heights of underground mine pools, their hydrostatic pressures and possible effect upon barrier pillars and mine dams protecting active mining operations, and acid mine-water drainage into surface streams and the unconsolidated valley fill. Under the closely related mine-water control program, a comprehensive series of mine pool monitoring stations have been installed, and additional phases of the project are proceeding in the Western, Middle, and Southern fields.

An overall program aimed at controlling fires in anthracite and other coal refuse banks continued in 1974. Efforts included investigations into the causes and environmental effects of these fires, attempts at their early detection and inventorying, and development of economic techniques for quenching and removing burning coal refuse banks.

Projects involving the reclamation of abandoned mine sites have been successful with the demonstration of different techniques. One project, completed in 1974, concluded that a mixture of anthracite fly ash, limestone, and fertilizer, spread and blended into the bank and then seeded with grasses and legumes, is successful and can be applied to other areas for reclamation.

The value of the longstanding map folio program to the public was demonstrated by the numerous requests received by the Bureau of Mines from various local authorities to evaluate subsurface conditions in relation to subsidence potential at proposed civic improvement sites, and possible structural failure in bridges and highways. Work continued on compiling surface and bed maps in stratigraphic sequence for selected areas.

Table 1.—Salient statistics of the Pennsylvania anthracite industry

	1970	1971	1972	1973	1974
Production:					
Preparation plants --- short tons --	9,304,221	8,323,168	6,618,205	6,377,512	6,454,385
Dredges ---------- do ----	409,354	389,609	476,792	441,076	150,468
Used at collieries for power and heat -------- do ----	15,823	14,548	11,298	11,373	12,013
Total production -------- do ----	9,729,398	8,727,325	7,106,295	6,829,961	6,616,866
Value -------------- thousands --	$105,341	$103,469	$85,251	$90,260	$144,695
Average sales realization per short ton on preparation plant shipments (excludes dredge coal):					
Pea and larger ----------	$15.06	$16.39	$17.18	$18.76	$30.41
Buckwheat No. 1 and smaller ------	$8.92	$9.90	$10.14	$11.30	$18.88
All sizes ----------	$11.03	$12.08	$12.40	$13.65	$22.19
Percentage of total preparation plant shipments (excludes dredge coal):					
Pea and larger ----------	34.4	33.6	32.0	31.4	28.8
Buckwheat No. 1 and smaller ------	65.6	66.4	68.0	68.6	71.2
Exports[1] ---------- short tons --	789,499	671,024	743,451	716,546	735,173
Consumption, apparent[2] ------- do ----	8,248,000	7,338,000	5,915,000	5,671,000	5,448,000
Average number of days worked --------	234	239	216	234	219
Average number of men working daily --	5,938	5,800	4,783	4,083	3,847
Output per man per day -- short tons --	7.10	6.30	6.88	7.15	7.87
Output per man per year ------ do ----	1,661	1,505	1,486	1,673	1,720
Quantity cut by machines ------ do ----	125,779	6,018	--	--	--
Quantity mined by stripping -- do ----	4,541,452	4,478,350	3,483,076	3,278,977	2,868,783
Quantity loaded by machines underground ---------- do ----	1,150,596	669,691	593,997	421,202	307,475
Distribution:					
Exports to Canada[1] ------- do ----	438,008	466,039	500,306	477,692	481,345
Loaded into vessels at Lake Erie[3] ---------- do ----	154,002	51,402	39,177	19,244	22,965

[1] U.S. Department of Commerce, 1968–74 export data does not include shipments to U.S. Military Forces. See NOTE, tables 4 and 25.

[2] Excludes shipments to U.S. Armed Forces.

[3] Ore and Coal Exchange, Cleveland, Ohio.

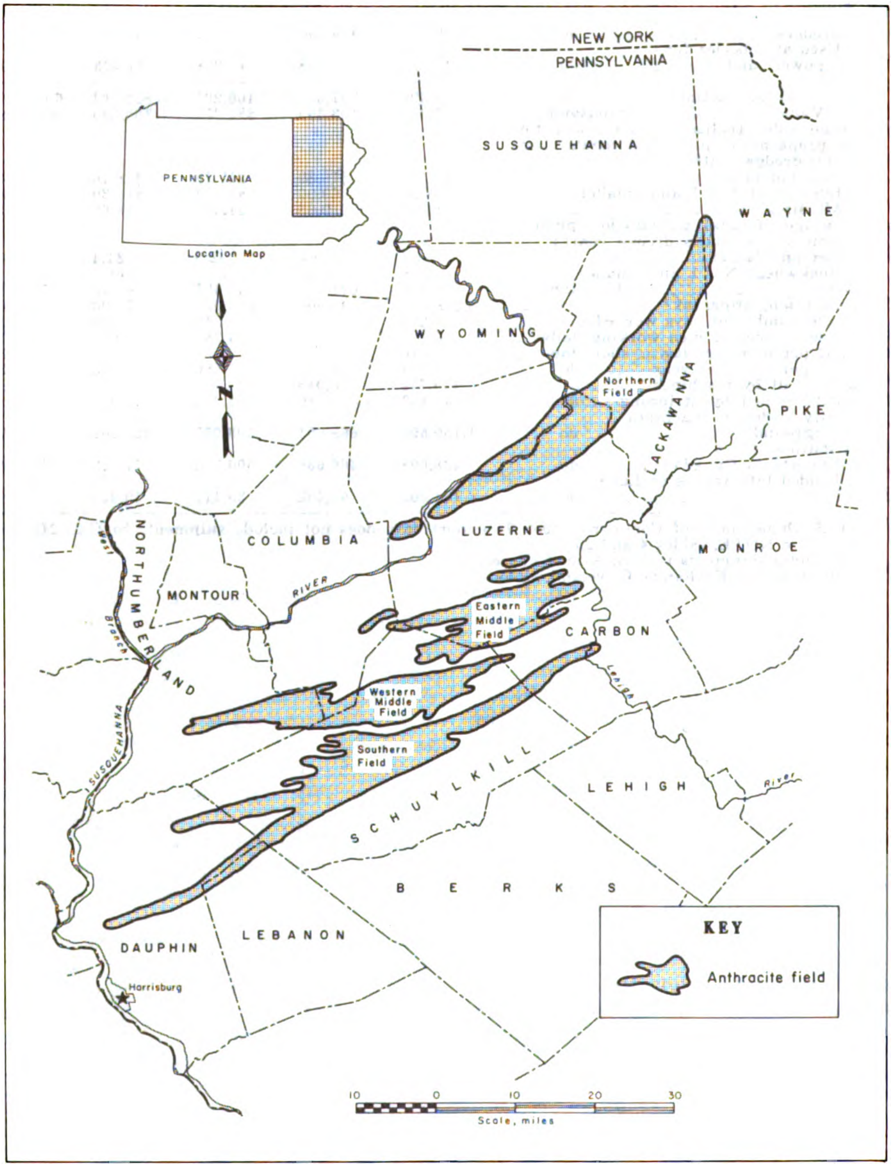

Figure 1.—Coalfields, regions, and counties of the Pennsylvania anthracite area.

DOMESTIC PRODUCTION

Production of Pennsylvania anthracite totaled 6.6 million tons in 1974, a decrease of 3% from that of 1973. Except for culm and silt recovery, all sources registered declines, ranging from approximately 9% for underground production to 66% for dredging operations. Underground production, which accounted for approximately 10% of the total output, continued its decline because of stringent and costly health and safety regulations, manpower shortages, and the high cost of pumping water from flooded mines. The output from underground mines in 1974 totaled approximately 657,000 tons, a decrease of 9% from that of 1973. The Schuylkill region accounted for 95% of the output, and the Wyoming region for the remainder. Strip pits accounted for 43% of the production (48% in 1973), culm and silt recovery for 45% (35% in 1973), and river coal for 2% (6% in 1973).

Two of the producing regions indicated losses in 1974. In the Lehigh region, total production was 6% less in 1974 because a 3% increase in production from strip pits was offset by a decrease of 23% in the recovery from culm banks. Production in the Wyoming region dropped 33% from that of 1973. The suspension of operations by a major coal company in the first half of the year inactivated the largest underground mine and strip operations in that region. Consequently, the underground output decreased by 80% and strip production by 70% from that of 1973. The bulk of the output was recovered from culm banks, which increased from 161,000 tons in 1973 to approximately 435,000 tons in 1974.

The Schuylkill region increased production 6% in 1974. The output from underground mines increased 12%; strip pits, 2%; culm and silt recovery, 26%; however, the recovery of river coal dropped approximately 66% in 1974.

Production of anthracite from strip mines totaled 2.8 million tons, a decrease of 13% from that of 1973. Production in the Schuylkill region totaled 1.5 million tons, an increase of 2%; the Lehigh region yielded 1.2 million tons, an increase of 3%; and in the Wyoming region, strip production totaled 208,000 tons, a 70% decline from that of 1973.

Culm and silt recovery totaled 2.9 million tons, an increase of approximately 556,000 tons, or 23% above the 1973 output. The Schuylkill region indicated a slight increase providing 69% of the total recovered in 1974, compared with 68% in 1973. The Wyoming region provided 15% of the total (7% in 1973); and the Lehigh region recovered approximately 16% of the total (26% in 1973).

Dredging operations produced about 150,000 tons in 1974, compared with 441,000 tons in 1973, a drop of 66%. Several operations were discontinued because insufficient coal remained on the riverbed to make the salvage operations economically feasible.

Mechanical loading of underground anthracite in 1974 declined 27% from the 1973 level, with a concurrent decrease of 10% in the loading units. Of the total underground output, 47% was loaded mechanically, compared with 58% in 1973. In operation were approximately 64 scraper loaders, 6 mobile loaders, and 41 conveyor and pit-car loaders.

Equipment used in the stripping operations and culm recovery consisted of 146 front-end loaders, 43 power shovels, and 105 draglines, a decrease of 2% from that of 1973.

The three leading counties in the production of anthracite were Schuylkill County, with a total of 3.1 million tons; Luzerne County, 1.5 million tons; and Northumberland County, 1.2 million tons. Other counties producing anthracite were Berks, Carbon, Columbia, Dauphin, Lackawanna, Snyder, Sullivan, and Susquehanna.

DISTRIBUTION

Reports submitted voluntarily to the Bureau of Mines by producers, wholesalers, and exporting firms indicated that 6,236,231 tons of Pennsylvania anthracite (a decrease of 2% from that of 1973) was shipped during the 1974 calendar year. Where possible, coal used largely for generating electricity and colliery fuel was eliminated from the statistics. Of the total shipped to market during the year, 81% was destined to points in the United States (a decrease of 2%), exports to Canada totaled 8% (an increase of approximately 1%), and 11% was exported to countries other than Canada.

In the United States market, shipments of pea and larger sizes declined 13%, but the buckwheat No. 1 and smaller sizes increased 2%. Canadian receipts of the pea and larger sizes decreased 16%, but the buckwheat No. 1 and smaller sizes, increased 4%. Exports to countries other than Canada indicated a decrease of 3% in the pea and larger sizes; however, the buckwheat No. 1 and smaller sizes increased 8% above that of 1973.

Shipments to the New England States totaled 53,796 tons, a decrease of 8% from that of 1973; to the Middle Atlantic States, 4,140,808 tons, a decrease of 4%; and to the Lake States, 349,165 tons, a decrease of less than 1%. However, the South Atlantic States and the "Other States" indicated increases of 6% and 12%, respectively, over that of 1973.

Of the total anthracite distributed, 3,594,337 tons was shipped by truck, and the remainder by rail.

Additional details of anthracite distribution for 1974 are presented in a Bureau of Mines report.[2]

CONSUMPTION AND USES

Apparent consumption of Pennsylvania anthracite in the United States in 1974, calculated as production minus exports, including shipments to the U.S. Armed Forces in West Germany, totaled 5.4 million short tons, compared with 5.7 million tons in 1973, a decrease of 4%. Consumption of anthracite in space heating declined 12% from that of 1973. The decline was due in part to the shortage of domestic sizes when a major coal company suspended operations in the first half of the year. Electric utilities consumed 1,498,000 tons of anthracite, an increase of 4% over that of 1973. Although the steel industry indicated a decline of 5% in the coke making category, the consumption of anthracite for sintering and pelletizing increased 59% over that of 1973.

Overall consumption of anthracite in 1974 was as follows: Space heating, 47% (51% in 1973); electric utilities, 28% (25% in 1973); coke making, 8% (8% in 1973); and sintering and pelletizing, 7% (4% in 1973); the remaining 10% was distributed among cement plants, colliery fuel, and other uses.

STOCKS

Monthly data on stocks held at retail dealers' yards indicated an inventory of 91,000 tons at yearend 1974, a decrease of 14% from that of yearend 1973. Electric utilities reported a decrease of 13% in inventories—930,000 tons at yearend 1974, compared with 1,066,000 tons at the end of 1973. Stocks at coke plants totaled 172,000 tons at yearend 1974, an increase of 77% over the 97,000 tons at yearend 1973. Stocks at Upper Lake docks (Lake Superior and Lake Michigan) comprised less than 500 tons at yearend 1974, relatively comparable to those of yearend 1973.

PRICES AND SPECIFICATIONS

Based on total production including colliery fuel and dredge coal, the average value per ton for 1974 was $21.87 f.o.b. preparation plant, compared with $13.22 per ton in 1973, an increase of 65%. The average value per ton of the larger sized groups was $30.41 f.o.b. preparation plant, an increase of $11.65 from that recorded in 1973. The prices for individual sizes (excluding dredge coal) were as follows: Egg, $32.91 (an increase of $13.35); stove, $31.54 (an increase of $12.03); chestnut, $31.06 (an increase of $11.76); and pea, $27.61 (an increase of $10.63).

The average value of the smaller sized

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[2] U.S. Bureau of Mines. "Distribution of Pennsylvania Anthracite For The Calendar Year, 1974." Mineral Industry Surveys, Oct. 6, 1975, 8 pp.

groups was $18.88 per ton f.o.b. preparation plant, compared with $11.30 in 1973. The individual prices for the smaller sized groups were buckwheat No. 1, $28.36 (an increase of $11.75); buckwheat No. 2 (rice), $26.73 (an increase of $9.96); buckwheat No. 3 (barley), $23.16 (an increase of $9.04); buckwheat No. 4, $19.35 (an increase of $8.57); buckwheat No. 5, $18.82 (an increase of $10.42); and the "Other" category, $8.77 (an increase of $2.99).

Production of domestic sizes indicated a drop of 29% in 1974; however, the industrial sizes increased from 69% of the total in 1973 to 71% in 1974.

Average wholesale prices as quoted in the Black Diamond magazine f.o.b. preparation plant were as follows: Egg and stove, $22.50 to $42.50; chestnut, $21.75 to $42.75; pea, $19.50 to $37.50; buckwheat No. 1, $19.50 to $37.50; buckwheat No. 2, $19.50 to $37.50 and buckwheat No. 3 (barley), $18.50 to $36.50.

FOREIGN TRADE

According to data released by the U.S. Bureau of the Census, 735,173 short tons of Pennsylvania anthracite was exported in 1974, an increase of approximately 3% above that shipped in 1973. Of that total, 65% was exported to Canada, an increase of 1% over that in 1973; 27% to Europe; and the remainder to other countries. Exports to South America and to Asia decreased 72% and 26%, respectively. Among the European countries, shipments to France increased 57% over those of 1973, but exports to the Netherlands, Sweden, and Italy declined 71%, 66%, and 34%, respectively.

Census export data in table 25 indicate that approximately 199,000 tons of anthracite was shipped to Europe in 1974. However, these figures do not include anthracite shipped abroad for the use of U.S. Armed Forces in West Germany. Therefore, a more accurate measurement of exports can be obtained by adding the military tonnage (approximately 434,000 tons) to the tonnage reported by the Bureau of the Census. Consequently, a total of 1,169,000 tons of anthracite was exported in 1974.

WORLD REVIEW

World production in 1974 totaled approximately 206 million short tons, an increase of 6% over the revised total of 194 million tons in 1973. The combined production of the U.S.S.R., North Korea, and the People's Republic of China totaled approximately 152 million tons, or 73% of the total world production. The U.S.S.R., North Korea and the People's Republic of China had production increases of 3%, 10%, and 27%, respectively. Other countries registering increases in 1974 were Ireland, 27%; Romania, 37%; and West Germany, 2%. Declines were indicated in Belgium, 19%; Bulgaria, 8%; France, 16%; the Netherlands, 55%; Spain, 2%; and the United Kingdom, 11%.

Imports of anthracite into Japan in 1974 totaled 1.6 million short tons, or an increase of 5% over that of 1973. The principal sources were North Vietnam, 732,386 short tons; the People's Republic of China, 404,385 tons; and North Korea, 260,987 tons. The remainder, in descending order, was imported from Canada, the U.S.S.R., the Republic of South Africa, the Republic of Korea, South Vietnam, and the United States. Gas plants consumed approximately 83,000 short tons; coke plants, 159,000 tons; chemical plants, 93,000 tons; briquet plants, 925,000 tons; and 418,000 tons was consumed for other industrial uses.

Production of anthracite in the Republic of Korea totaled approximately 17 million short tons in 1974, an increase of 12% over that of 1973. An anthracite seam has been discovered in the Unsong area in Kyongsank Pukto (Province), with estimated reserves of 1 million tons. Most of Korea's present reserves are anthracite. Currently more than 90% of the anthracite production is consumed as domestic heating fuel. The South Korean Government, in a move to boost production and reduce domestic consumption, has raised the price

38%. Recent developments in world energy markets have resulted in the increased value of domestically produced anthracite in direct proportion to the rising price of crude oil.

North Vietnam produced 4 million tons of anthracite in 1974, an increase of 33% over that of 1973. Coal is North Vietnam's most important mineral with respect to value in foreign trade. The largest deposit, the Quang-Yen basin, forms a shallow arc extending approximately 95 miles from Sept Pagodas in the west to Tien Yen in the east, and further extends to Ke-bao Island. The deposit is predominately anthracite, with small amounts of other rank coals.

Production of anthracite in Spain totaled 3 million short tons in 1974, a decrease of 2% from that in 1973. During the first 9 months of 1974, imports totaled 6,264 short tons, a 36% decline from the same period in 1973. However, in the same period of time, exports increased from 5,467 tons in 1973 to 58,352 tons in 1974.

The U.S.S.R.'s production of anthracite in 1974 was approximately 87 million short tons, an increase of 3% over that in 1973. Of the 5 million tons exported, 1,268,000 short tons was shipped to France, 172,000 tons to Italy, 29,762 tons to Austria, and the remainder to other countries.

TECHNOLOGY

The Federal Bureau of Mines is currently investigating a process of selective flocculation as a possible means of recovering ultrafine coal particles from slimes. Such slimes remain substantially unaffected by conventional coal-washing methods and are discarded. This results in the loss of a valuable resource and generates water pollution and solid-waste-disposal problems.

Flocculation is the coalescence of minute particles into larger aggregates. Traditionally, the principal objectives have been to increase settling rates and to improve filtration and centrifugation characteristics. "Selective flocculation," as the term implies, refers to the agglomeration of one component of an admixture, the other remaining dispersed. Accomplishing this depends essentially on finding a flocculant that is preferentially adsorbed on one component under a given set of conditions.

Development of selective flocculation technology is presently aimed in several directions. In line with common coal-cleaning practices, attempts are being made to separate clean coal from the associated high-ash refuse. In addition, efforts will be made to separate or concentrate various petrographic constituents of clean coal. An application of the latter technique would be, for example, to reduce the concentration of fusain, which is inert in coking operations and in liquefaction processes.

The Bureau of Mines initiated a series of subsidence control projects and successfully demonstrated that surface stability over mined areas can be achieved.[8]

Many abandoned mine openings are inaccessible because of flooding or extensive caving. Such openings must be flushed blindly. A new technique for blind flushing inaccessible mine workings has recently been developed. This technique differs from the open gravity-feed methods previously described in that energy is used to achieve a dynamic suspension of solid particles, and the system is completely closed from the point of slurry mixing to the bottom of the injection hole.

In the pumped-slurry process, granular material is blended with water, and the suspension (slurry) is pumped to the point of deposition. Water from an inundated mine may be used and recirculated, or water from an external source may be used without being recirculated. During mixing, each solid particle becomes enclosed by fluid so that friction during transit is reduced. The slurry is pumped continuously from the mixing tank through a pipeline on the surface, then down through a borehole to the mine opening. The energy provided by the pump and the static head in the borehole give the velocity required to keep the solid particles in suspension and to transport them.

The completeness of filling in the open spaces is responsive to alterations in the velocity of flow, which changes with the growth of the mound of deposited solids. As the slurry first enters the open space from the injection hole, its velocity drops rapidly, solid particles settle out near the borehole, forming a doughnut-shaped mound on the mine floor. As the height of the mound approaches the mine roof, the velocity of the slurry increases through the narrowing channel, and solid particles are transported to the outer limit of the mound. Here the velocity decreases abruptly and solids are deposited. This type of deposition continues, and the mound of deposited fill builds outward. As resistance to flow of the slurry develops in one direction, a new channel is formed in another direction along a line of less resistance. Eventually nearly all mine openings are filled. The lateral extent of the fill is determined largely by the available energy in the system. As the mound of fill material builds outward into the mine, the flow channels between the mound and the mine roof become longer and resistance to flow increases. When this resistance, combined with resistance in the pipe, becomes great enough to reduce the velocity of the slurry below that required to transport the solid particles, transportation of the particles ceases. The particles then settle out, and the passage becomes filled.

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[8] Whaite, R. H., and A. S. Allen. Pumped-Slurry Backfilling of Inaccessible Mine Workings for Subsidence Control. BuMines IC 8667, 1975, pp. 6–8.

The pumped-slurry method of blind flushing has the following advantages over the open gravity-feed method previously used:

1. Greater reduction in the number of injection bore-holes required. A single injection hole serves the purpose of many injection holes in the gravity-feed method.
2. More complete vertical filling of mine openings.
3. More complete areal coverage. Areas inaccessible because of surface improvements can be filled.
4. Less disruption of the community in the form of noise, dust, and traffic interference by drilling operations and trucking of fill material.

Table 2.—Standard anthracite specifications approved and adopted by the Anthracite Committee, effective July 28, 1947

Size	Round test mesh (inches)	Percent					
		Oversize maximum	Undersize		Maximum impurities[1]		
			Maximum	Minimum	Slate	Bone	Ash[2]
Broken	Through 4 3/8	--	--	--	1½	2	11
	Over 3 1/4 to 3	--	15	7½	--	--	--
Egg	Through 3 1/4 to 3	5	--	--	1½	2	11
	Over 2 7/16	--	15	7½	--	3	11
Stove	Through 2 7/16	7½	--	--	2	3	11
	Over 1 5/8	--	15	7½	--	--	--
Chestnut	Through 1 5/8	7½	--	--	3	4	11
	Over 13/16	--	15	7½	--	--	--
Pea	Through 13/16	10	--	--	4	5	12
	Over 9/16	--	15	7½	--	--	--
Buckwheat No. 1	Through 9/16	10	--	--	--	--	13
	Over 5/16	--	15	7½	--	--	--
Buckwheat No. 2	Through 5/16	10	--	--	--	--	13
(rice)	Over 3/16	--	17	7½	--	--	--
Buckwheat No. 3	Through 3/16	10	--	--	--	--	15
(barley)	Over 3/32	--	20	10	--	--	--
Buckwheat No. 4	Through 3/32	20	--	--	--	--	15
	Over 3/64	--	30	10	--	--	--
Buckwheat No. 5	Through 3/64	30	No limit		--	--	16

[1] When slate content in sizes from broken to chestnut, inclusive, is less than the above standards, bone content may be increased 1½ times the decrease in slate content under the allowable limits, but slate content specified above shall not be exceeded in any event.

A tolerance of 1% is allowed on maximum percentage of undersize and maximum percentage of ash content.

Maximum percentage of undersize is applicable only to anthracite as it is produced at preparation plant.

Slate is defined as any material that has less than 40% fixed carbon.

Bone is defined as any material that has 40% or more, but less than 75%, fixed carbon.

[2] Ash determinations are on a dry basis.

Table 3.—Summary of monthly developments in the Pennsylvania anthracite industry in 1974

(Thousand short tons, except as otherwise indicated)

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total 1974	Change from 1973 (percent)	Total 1973
Production (including mine fuel, local sales, and dredge coal)	516	458	531	563	589	505	443	620	516	641	610	625	6,617	−3.1	6,830
Shipments (breakers and washeries only, all sizes):															
By rail[1]	231	211	253	284	292	265	245	286	207	259	257	229	3,019	−3.6	3,133
By truck[2]	375	295	281	313	271	325	295	326	344	362	394	336	3,917	+3.9	3,771
Carloadings[3]	3	2	3	4	4	3	3	4	3	4	3	3	39	−25.0	52
Distribution:															
Lake Erie loadings[4]	--	--	--	--	--	2	--	--	7	11	3	--	23	+21.1	19
Upper Lake dock trade:[5]															
Receipts	(6)	(6)	(6)	(6)	(6)	(6)	(6)	(6)	(6)	(6)	(6)	(6)	2	+100.0	1
Deliveries (reloadings)	(6)	(6)	(6)	(6)	(6)	(6)	(6)	(6)	(6)	(6)	(6)	(6)	2	+100.0	1
Exports[7]	39	12	40	80	105	43	49	59	37	78	89	104	735	+2.7	716
Industrial consumption and stocks by:															
Electric utilities:[8]															
Consumption	123	108	97	111	139	138	129	136	126	138	116	137	1,498	+3.9	1,442
Stocks	1,027	989	1,007	1,000	964	931	933	919	906	907	925	930	930	−12.8	1,066
Coke plants:															
Used for carbonizing	41	36	39	37	37	34	34	41	34	36	35	40	444	−4.9	467
Stocks	85	76	70	65	89	78	78	119	151	164	170	172	172	+77.3	97
Stocks on Upper Lake docks:[5]															
Lake Superior	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Lake Michigan	(6)	1	1	(6)	1	1	1	1	1	(6)	(6)	(6)	(6)	--	--
Stocks in retail dealer yards:[9]															
Chestnut and larger	65	61	63	69	70	80	74	71	60	69	78	68	68	+4.6	65
Pea	9	7	6	6	5	5	5	6	6	6	7	7	7	−30.0	r 10
Buckwheat No. 1 and No. 2	27	22	24	27	25	23	22	22	20	17	19	16	16	−48.4	31
Total	101	90	93	102	100	108	101	99	86	92	104	91	91	−14.2	106

Retail dealer deliveries:[9]															
Chestnut and larger	63	56	42	27	9	9	12	16	28	25	21	13	321	—25.3	430
Pea	37	37	29	19	10	18	19	60	41	41	37	42	390	+51.2	258
Buckwheat No. 1 and No. 2	31	37	27	20	16	10	17	30	27	26	24	59	324	—16.5	388
Total	131	130	98	66	35	37	48	106	96	92	82	114	1,035	—3.8	1,076
Wholesale price indexes (1957–59=100):[10]															
F.o.b. car at mines:															
Chestnut	165.3	174.2	174.2	199.0	199.0	199.0	229.0	240.3	260.9	271.2	319.0	319.0	229.2	+49.6	153.2
Buckwheat No. 1	197.0	207.0	207.0	227.2	227.2	227.2	276.4	278.0	315.8	328.4	378.9	378.9	270.8	+46.4	185.0

[r] Revised.
[1] Furnished by initial carriers.
[2] Pennsylvania Department of Mines and Mineral Industries.
[3] Association of American Railroads.
[4] Ore and Coal Exchange, Cleveland, Ohio.
[5] Data furnished by Lake dock operators.
[6] Less than ½ unit.
[7] U.S. Department of Commerce. Does not include shipments to the U.S. military forces.
[8] Federal Power Commission.
[9] Estimated from reports submitted by a selected list of retail dealers located outside the producing region.
[10] Furnished by the Bureau of Labor Statistics from data obtained from authorized trade publications.

NOTE.—According to the Association of American railroads, 589,714 short tons of anthracite was exported to Europe during 1974 compared with 659,516 short tons for 1973. Of this total, 412,611 short tons was consigned to West Germany and the Netherlands, including exports to the U.S. military forces. This compares with 436,507 short tons for 1973.

Table 4.—Project report

Project location	Project description	Sponsor	Status of report
ACID COAL MINE DRAINAGE			
Anthracite fields	Monthly measurements of mine water levels and overflows.	U.S. Geological Survey and Federal Bureau of Mines.	Continuous.
Columbia, Northumberland, and Schuylkill Counties.	Mine Drainage Project No. 46, Phase D construction of mine water pool monitoring stations.	Federal Bureau of Mines and Commonwealth of Pennsylvania.	Work started in 1974.
Lackawanna County:			
Jermyn Borough	Stream pollution abatement	Commonwealth of Pennsylvania.	Work in progress 1974.
Lackawanna River	Pollution abatement	do	Do.
SURFACE SUBSIDENCE			
Lackawanna County:			
Olyphant Borough	Demonstration project for hydraulic backfilling into inaccessible mine voids to establish limitations in the use of the pumped slurry.	do	Work started 1974.
Scranton and Green Ridge.	Demonstration project for fill of mine voids under approximately 35 acres of Green Ridge section of Scranton.	Commonwealth of Pennsylvania and Federal Bureau of Mines.	Work started 1972. Still in progress.
Scranton, Minooka section.	Filling mine voids. Blind flushing approximately 17 acres of a pilot demonstration project.	do	Work in progress 1974.
Scranton, Southside section.	Hydraulic flushing of mine voids, Project II.	do	Do.
Scranton, Hill section.	Filling abandoned mine voids	do	Do.
Carbondale West	Appalachian subsidence control, Project 8.	do	Do.
UNDERGROUND MINE FIRES			
Columbia County:			
Centralia Borough	Appalachia mine fire control, which includes Phase I exploratory drilling, Phase II (1) underground barrier pillars formed by injecting fly ash into mine void of west barrier, and Phase II (2) underground barrier pillars formed by injecting fly ash into mine void east barrier.	do	Work completed in 1974.
Lackawanna County: Eddy Creek, Boroughs of Throop and Olyphant.	Mine fire control—using a pumped slurry backfilling method of burned breakers refuse material.	do	Work started 1974.
SURFACE MINE RECLAMATION PROJECTS			
Lackawanna County:			
Scranton, Cedar Avenue.	Revegetation project of barren mine lands research demonstration.	do	Work started 1974.
Scranton, Taylor Borough.	Keyser Valley strip mine area reclamation demonstration project, Part III.	do	Work in progress 1974.
Luzerne County: Preston	Conservation and Development-Refuse bank reclamation demonstration project on the feasibility of using anthracite fly ash as a soil amendment together with lime, grass seeds, and legumes to vegetate the surface. Project is under the direction of the Energy Research Center at Morgantown, W. Va.	do	Started 1973. Still in progress.

Table 5.—Sizes of Pennsylvania anthracite (excluding dredge coal) prepared at plants, by region

(Percent)

Size	1970	1971	1972	1973	1974	1970	1971	1972	1973	1974
	Lehigh region					Schuylkill region				
Lump[1] and broken	--	--	--	--	--	--	--	--	--	--
Egg	4.0	4.6	2.4	4.6	5.4	1.0	0.9	0.3	0.3	.1
Stove	9.4	10.9	10.8	12.9	14.4	10.7	10.4	10.2	9.1	7.6
Chestnut	11.1	11.0	10.6	9.9	12.8	12.3	10.7	10.1	9.4	8.6
Pea	9.2	9.9	8.5	8.5	9.9	8.3	7.4	6.9	6.8	6.5
Total pea and larger	33.7	36.4	32.3	35.9	42.5	32.3	29.4	27.5	25.6	22.8
Buckwheat No. 1	10.2	10.6	12.1	11.3	12.1	11.0	10.2	9.0	8.7	7.5
Buckwheat No. 2 (rice)	9.4	10.7	9.0	9.0	11.3	9.8	8.9	8.8	8.3	7.5
Buckwheat No. 3 (barley)	11.9	10.1	9.1	9.4	11.1	13.1	12.7	12.2	11.2	10.2
Buckwheat No. 4	7.2	5.6	5.9	5.6	5.9	6.8	9.6	10.3	8.5	7.3
Buckwheat No. 5	14.7	12.1	14.5	14.5	16.0	13.5	20.4	22.0	20.4	20.3
Other[2]	12.9	14.5	17.1	14.3	1.1	13.5	8.8	10.2	17.3	24.4
Total buckwheat No. 1 and smaller	66.3	63.6	67.7	64.1	57.5	67.7	70.6	72.5	74.4	77.2
	Wyoming region					Total				
Lump[1] and broken	--	(3)	--	--	--	--	(3)	--	--	--
Egg	2.4	1.9	1.7	2.1	1.9	2.1	2.1	1.1	1.7	1.6
Stove	10.3	13.0	13.6	14.1	6.8	10.3	11.1	11.0	11.0	9.3
Chestnut	15.5	12.7	15.6	13.8	14.0	12.7	11.2	11.4	10.2	10.3
Pea	11.5	12.7	12.9	14.4	8.3	9.3	9.2	8.5	8.5	7.6
Total pea and larger	39.7	40.3	43.8	44.4	31.0	34.4	33.6	32.0	31.4	28.8
Buckwheat No. 1	15.4	17.1	16.4	15.9	7.8	11.8	11.8	11.2	10.7	8.7
Buckwheat No. 2 (rice)	8.7	8.8	9.8	9.1	5.5	9.4	9.3	9.1	8.6	8.2
Buckwheat No. 3 (barley)	10.7	11.0	11.5	13.1	11.8	12.2	11.6	11.3	11.0	10.6
Buckwheat No. 4	5.3	4.3	4.4	5.4	10.3	6.6	7.4	8.0	7.2	7.2
Buckwheat No. 5	4.5	3.4	2.5	2.7	1.2	11.8	14.6	16.1	15.9	17.2
Other[2]	15.7	15.1	11.6	9.4	32.4	13.8	11.7	12.3	15.2	19.3
Total buckwheat No. 1 and smaller	60.3	59.7	56.2	55.6	69.0	65.6	66.4	68.0	68.6	71.2

[1] Quantity of lump included is insignificant.
[2] Includes various mixtures of buckwheat Nos. 2 to 5 and coal of relatively low dollar value.
[3] Less than 0.05%.

Table 6.—Commercial production of Pennsylvania anthracite in 1974, by region and size

Size	From preparation plants												From river dredging			Total [2]		
	Lehigh region			Schuylkill region			Wyoming region [1]			Total [2]								
	Rail	Truck	Total [2]	Rail	Truck	Total [2]	Rail	Truck	Total [2]	Rail	Truck	Total	Rail	Truck	Total [2]	Rail	Truck	Total
Quantity, thousand short tons:																		
Egg	76	13	89	1	2	3	13	(4)	13	90	15	105	--	--	--	90	15	105
Stove	185	54	239	166	147	313	37	9	46	388	210	598	--	--	--	388	210	598
Chestnut	89	124	213	147	208	355	43	52	95	279	384	663	--	--	--	279	384	663
Pea	58	106	165	89	178	267	14	43	56	161	327	488	--	--	--	161	327	488
Total pea and larger [2]	409	297	706	402	535	937	107	104	210	917	936	1,853	--	--	--	917	936	1,853
Buckwheat No. 1	108	93	200	104	204	307	10	42	53	222	339	560	--	--	--	222	339	560
Buckwheat No. 2 (rice)	11	177	187	54	254	308	5	32	37	71	462	532	--	--	--	71	462	532
Buckwheat No. 3 (barley)	56	130	185	130	290	420	18	61	80	204	481	685	--	--	--	204	481	685
Buckwheat No. 4	70	28	98	168	133	301	18	52	70	256	212	468	--	--	--	256	212	468
Buckwheat No. 5	172	93	265	443	396	839	6	2	8	621	490	1,111	3	137	140	623	628	1,251
Other [3]	--	19	19	66	940	1,006	23	197	220	89	1,156	1,245	--	11	11	89	1,166	1,255
Total buckwheat No. 1 and smaller [2]	415	539	954	966	2,215	3,181	80	386	466	1,462	3,140	4,601	3	148	150	1,464	3,288	4,752
Grand total [2]	824	837	1,660	1,368	2,749	4,118	187	490	677	2,379	4,075	6,454	3	148	150	2,382	4,223	6,605
Value, thousands:																		
Egg	$2,534	$428	$2,962	$22	$63	$85	$392	$2	$394	$2,948	$493	$3.441	--	--	--	$2,948	$493	$3,441
Stove	5,722	1,678	7,399	5,344	4,735	10,080	1,050	330	1,379	12,116	6,743	18,858	--	--	--	12,116	6,743	18,858
Chestnut	2,637	3,772	6,408	4,848	6,631	11,480	1,063	1,626	2,689	8,548	12,029	20,577	--	--	--	8,548	12,029	20,577
Pea	1,485	2,960	4,445	2,501	5,086	7,587	294	1,150	1,443	4,280	9,196	13,476	--	--	--	4,280	9,196	13,476
Total pea and larger [2]	12,378	8,838	21,215	12,715	16,515	29,230	2,799	3,107	5,906	27,892	28,460	56,352	--	--	--	27,892	28,460	56,352
Buckwheat No. 1	3,224	2,659	5,882	2,979	5,555	8,534	295	1,177	1,471	6,497	9,391	15,888	--	--	--	6,497	9,391	15,888
Buckwheat No. 2 (rice)	310	4,667	4,977	1,514	6,719	8,233	110	912	1,021	1,934	12,297	14,231	--	--	--	1,934	12,297	14,231
Buckwheat No. 3 (barley)	1,434	2,975	4,409	3,069	6,631	9,700	401	1,344	1,745	4,904	10,950	15,854	--	--	--	4,904	10,950	15,854
Buckwheat No. 4	1,359	519	1,878	3,703	2,471	6,175	242	768	1,009	5,304	3,758	9,062	--	--	--	5,304	3,758	9,062
Buckwheat No. 5	3,628	1,805	5,433	8,109	7,259	15,368	93	18	111	11,830	9,082	20,912	21	1,090	1,111	11,851	10,172	22,023
Other [3]	--	116	116	573	7,889	8,462	225	2,116	2,341	798	10,121	10,920	--	84	84	798	10,205	11,003
Total buckwheat No. 1 and smaller [2]	9,955	12,740	22,695	19,948	36,524	56,472	1,364	6,334	7,699	31,267	55,598	86,866	21	1,174	1,195	31,287	56,772	88,060
Grand total [2]	22,332	21,577	43,910	32,663	53,039	85,702	4,164	9,441	13,605	59,159	84,058	143,217	21	1,174	1,195	59,179	85,232	144,411

Average value per ton:[4]																	
Egg	$33.23	$33.27	$33.28	$33.41	$34.00	$33.85	$30.44	$35.00	$30.46	$32.83	$33.37	$32.91	--	--	--	$32.83	$33.37	$32.91
Stove	30.94	31.04	30.96	32.27	32.18	32.23	28.24	37.09	29.95	31.25	32.09	31.54	--	--	--	31.25	32.09	31.54
Chestnut	29.63	30.34	30.04	33.01	31.93	32.38	24.78	31.39	28.40	30.66	31.34	31.06	--	--	--	30.66	31.34	31.06
Pea	25.48	27.87	27.02	28.01	28.59	28.40	21.59	26.82	25.56	26.56	28.12	27.61	--	--	--	26.56	28.12	27.61
Total pea and larger	30.30	29.71	30.05	31.60	30.89	31.20	26.26	29.99	28.10	30.40	30.42	30.41	--	--	--	30.40	30.42	30.41
Buckwheat No. 1	29.98	28.62	29.35	28.69	27.29	27.77	28.99	27.79	28.02	29.33	27.72	28.36	--	--	--	29.33	27.72	28.36
Buckwheat No. 2 (rice)	28.60	26.44	26.56	27.84	26.50	26.74	19.93	28.72	27.57	27.42	26.63	26.73	--	--	--	27.42	26.63	26.73
Buckwheat No. 3 (barley)	25.80	22.94	23.80	23.56	22.90	23.11	22.11	21.87	21.92	24.04	22.78	23.16	--	--	--	24.04	22.78	23.16
Buckwheat No. 4	19.51	18.44	19.20	22.01	18.65	20.53	13.53	14.81	14.48	20.73	17.68	19.35	--	--	--	20.73	17.68	19.35
Buckwheat No. 5	21.14	19.34	20.51	18.31	18.34	18.33	14.47	12.08	14.01	19.06	18.51	18.82	8.00	7.93	7.94	19.01	16.20	17.60
Other[3]	--	6.25	6.25	8.63	8.39	8.41	10.00	10.73	10.66	8.98	8.76	8.77	--	8.00	8.00	8.98	8.75	8.77
Total buckwheat No. 1 and smaller[2]	23.97	23.63	23.78	20.65	16.49	17.76	16.98	16.41	16.51	21.39	17.71	18.88	8.00	7.94	7.94	21.37	17.27	18.53
Grand total	27.11	25.79	26.45	23.87	19.29	20.81	22.27	19.28	20.11	24.87	20.62	22.19	8.00	7.94	7.94	24.85	20.18	21.87

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[1] Includes Sullivan County.
[2] Data may not add to totals shown because of independent rounding.
[3] Includes various mixtures of buckwheat Nos. 2 to 5 and coal of relatively low dollar value.
[4] Average value derived from actual, rather than rounded data.

Table 7.—Production of Pennsylvania anthracite in 1974, by region and county
(Thousand short tons and thousand dollars)

Source	Rail shipments		Truck shipments		Colliery fuel		Total production[1]	
	Quantity	Value[2]	Quantity	Value[2]	Quantity	Value	Quantity	Value[2]
				REGION				
Lehigh: Preparation plants	824	22,332	837	21,577	4	101	1,664	44,011
Schuylkill:								
Preparation plants	1,368	32,663	2,749	53,039	7	168	4,125	85,870
Dredges	3	21	148	1,174	--	--	150	1,195
Total Schuylkill[1]	1,371	32,683	2,897	54,213	7	168	4,275	87,064
Wyoming: Preparation plants[3]	187	4,164	490	9,441	1	15	677	13,620
Total:[1]								
Preparation plants	2,379	59,159	4,075	84,058	12	284	6,466	143,500
Dredges	3	21	148	1,174	--	--	150	1,195
Grand total[1]	2,382	59,179	4,223	85,232	12	284	6,617	144,695
				COUNTY				
Berks and Snyder	8	21	132	1,051	--	--	134	1,072
Carbon	201	4,705	45	600	--	--	246	5,305
Columbia	33	915	13	337	--	--	46	1,252
Dauphin	13	425	77	1,147	1	3	91	1,576
Lackawanna	69	1,714	98	2,857	([4])	5	168	4,576
Luzerne	578	15,915	908	21,658	4	103	1,490	37,676
Northumberland	479	9,526	731	12,512	2	37	1,212	22,075
Schuylkill	1,006	25,959	2,176	44,536	5	136	3,187	70,630
Sullivan	--	--	35	451	([4])	([4])	35	451
Susquehanna	--	--	7	83	--	--	7	83
Total[1]	2,382	59,179	4,223	85,232	12	284	6,617	144,695

[1] Data may not add to totals shown because of independent rounding.
[2] Value given for shipments is that at which coal left possession of producing company; does not include selling expenses.
[3] Includes Sullivan County.
[4] Less than 1,000 short tons.

Table 8.—Pennsylvania anthracite produced, by field
(Thousand short tons)

Field	1970	1971	1972	1973	1974
Eastern Middle: Breakers and washeries	1,511	1,519	1,221	1,288	1,156
Western Middle:					
Breakers and washeries	2,540	2,167	1,741	1,663	1,939
Dredges	W	W	W	W	W
Total	W	W	W	W	W
Southern:					
Breakers and washeries	3,183	2,849	2,333	2,427	2,693
Dredges	W	W	W	W	W
Total	W	W	W	W	W
Northern: Breakers and washeries[1]	2,086	1,802	1,334	1,011	677
Total:					
Breakers and washeries	9,320	8,337	6,629	6,389	6,466
Dredges	409	390	477	441	150
Grand total[2]	9,729	8,727	7,106	6,830	6,617

W Withheld to avoid disclosing individual company confidential data.
[1] Includes Sullivan County.
[2] Data may not add to totals shown because of independent rounding.

Table 9.—Pennsylvania anthracite produced in 1974, classified as fresh-mined, culm-bank, and river coal, by field and region

(Thousand short tons)

Source	Fresh-mined coal: Underground mines: Mechanically loaded	Fresh-mined coal: Underground mines: Hand loaded	Fresh-mined coal: Underground mines: Total[1]	Fresh-mined coal: Strip pits	From culm banks	From river dredging	Total[1]
FIELD							
Eastern Middle	--	--	--	955	201	--	1,156
Western Middle	37	62	98	579	1,262	W	W
Southern	237	288	525	1,127	1,041	W	W
Northern[2]	34	--	34	208	435	--	677
Total[1]	307	350	657	2,869	2,940	150	6,617
REGION							
Lehigh	--	--	--	1,196	468	--	1,664
Schuylkill	274	350	623	1,464	2,037	150	4,275
Wyoming	34	--	34	[2] 208	435	--	677
Total[1]	307	350	657	2,869	2,940	150	6,617

W Withheld to avoid disclosing individual company confidential data.

[1] Data may not add to totals shown because of independent rounding.

[2] Includes Sullivan County.

Table 10.—Production of Pennsylvania anthracite from strip pits

	Mined by stripping (thousand short tons)	Percent of fresh-mined total	Number employed	Average number of days worked
1970	4,541	72.3	1,855	234
1971	4,478	77.7	1,800	273
1972	3,483	78.7	2,011	261
1973	3,279	81.9	1,633	250
1974:				
Lehigh region	1,196	33.9	NA	NA
Schuylkill region	1,464	59.2	NA	NA
Wyoming region[1]	208	6.9	NA	NA
Total or average	[2] 2,869	81.4	p 1,376	p 244

p Preliminary. NA Not available.

[1] Includes Sullivan County.

[2] Data does not add to total shown because of independent rounding.

Table 11.—Power shovels, front-end loaders, and draglines used in recovering Pennsylvania anthracite from culm banks and stripping, by type of power

Type of power	1972: Front-end loaders	1972: Power shovels	1972: Draglines	1972: Total	1973: Front-end loaders	1973: Power shovels	1973: Draglines	1973: Total	1974: Front-end loaders	1974: Power shovels	1974: Draglines	1974: Total
Gasoline	--	--	1	1	--	--	1	1	--	2	2	4
Electric	--	19	42	61	--	16	34	50	--	14	30	44
Diesel	103	41	75	219	138	34	77	249	146	27	73	246
Diesel-electric	--	--	--	--	--	--	--	--	--	--	--	--
Total	103	60	118	281	138	50	112	300	146	43	105	294

Table 12.—Production of Pennsylvania anthracite from culm banks, by region

(Thousand short tons)

Year	Lehigh region	Schuylkill region	Wyoming region	Total
1970	921	1,591	524	3,036
1971	729	1,544	300	2,573
1972	614	1,411	177	2,202
1973	611	1,612	161	2,384
1974	468	2,037	435	2,940

Table 13.—Estimated production of Pennsylvania anthracite in 1974, by week[1]

Week ended—	Thousand short tons	Week ended—	Thousand short tons	Week ended—	Thousand short tons
Jan. 5[2]	78	May 18	123	Sept. 28	140
12	91	25	121	Oct. 5	138
19	125	June 1	101	12	130
26	130	8	119	19	135
Feb. 2	114	15	113	26	168
9	108	22	115	Nov. 2	127
16	104	29	158	9	151
23	118	July 6	65	16	156
Mar. 2	139	13	70	23	151
9	138	20	103	30	125
16	116	27	135	Dec. 7	168
23	117	Aug. 3	123	14	141
30	127	10	125	21	136
Apr. 6	120	17	130	28	147
13	109	24	135	Jan. 4	33
20	132	31	177		
27	146	Sept. 7	97	Total	6,617
May 4	143	14	134		
11	157	21	115		

[1] Estimated from weekly carloadings as reported by the Association of American Railroads and other factors; adjusted to annual production from Bureau of Mines canvass.

[2] Figures represent production in that part of week included in calendar year shown.

Table 14.—Estimated monthly production of Pennsylvania anthracite[1]

(Thousand short tons)

Month	1970	1971	1972	1973	1974
January	808	725	583	522	516
February	770	654	542	568	458
March	814	780	622	641	531
April	759	795	487	581	563
May	763	782	706	641	589
June	809	740	515	609	505
July	707	620	465	434	443
August	898	813	688	587	620
September	880	767	611	532	516
October	895	710	682	614	641
November	815	685	650	582	610
December	811	656	555	519	625
Total	9,729	8,727	7,106	6,830	6,617

[1] Production is estimated from weekly carloadings, as reported by the Association of American Railroads, and includes mine fuel, coal sold locally, and dredge coal.

Table 15.—Pennsylvania anthracite loaded mechanically underground

(Thousand short tons)

Year	Scraper loaders		Mobile loaders		Conveyor and pit-car loaders		Total loaded mechanically[1]	
	Number of units	Quantity loaded	Number of units	Quantity loaded	Number of units	Quantity loaded	Number of units	Quantity loaded
1970	103	491	20	183	147	476	270	1,151
1971	95	319	18	151	91	199	204	670
1972	81	347	16	136	46	111	143	594
1973	72	220	4	106	47	96	123	421
1974	64	89	6	169	41	49	111	307

[1] Data may not add to totals shown because of independent rounding.

Table 16.—Trends in mechanical loading,[1] hand loading, and stripping of Pennsylvania anthracite

(Thousand short tons)

Year	Fresh-mined coal							
	Underground					Strip pits		
	Mechanical loading	Percent of total underground	Hand loading	Percent of total underground	Total	Quantity	Percent of fresh mined coal	Total
1970	1,151	66.1	591	33.9	1,742	4,541	72.3	6,283
1971	670	52.1	617	47.9	1,287	4,478	77.7	5,765
1972	594	62.9	350	37.1	944	3,483	78.7	4,427
1973	421	58.0	305	42.0	726	3,279	81.9	4,005
1974	307	46.8	350	53.2	657	2,869	81.4	3,526

[1] Mechanical loading includes coal handled on pit-car loaders and hand-loaded face conveyors.

Table 17.—Average sales realization of Pennsylvania anthracite (excluding dredge coal) at preparation plants, by region and size

(Per short ton)

Size	1970	1971	1972	1973	1974	1970	1971	1972	1973	1974
	Lehigh region					Schuylkill region				
Lump [1] and broken	--	--	--	--	--	--	$6.00	--	--	--
Egg	$14.90	$17.59	$18.32	$19.77	$33.23	$14.27	16.83	$16.58	$17.32	$33.85
Stove	14.98	16.62	17.67	19.37	30.96	15.35	16.65	17.56	19.35	32.23
Chestnut	15.19	16.47	17.39	19.11	30.04	15.29	16.58	17.23	18.96	32.38
Pea	13.56	14.60	15.60	16.36	27.02	13.46	15.00	15.33	16.86	28.40
Total pea and larger	14.65	16.14	17.08	18.64	30.05	14.81	16.21	16.87	18.52	31.20
Buckwheat No. 1	12.78	14.55	15.29	16.87	29.35	13.26	14.77	14.85	16.00	27.77
Buckwheat No. 2 (rice)	12.94	14.33	15.06	16.89	26.56	12.99	14.45	14.95	16.34	26.74
Buckwheat No. 3 (barley)	11.07	12.71	13.82	14.99	23.80	11.05	12.30	12.36	13.82	23.11
Buckwheat No. 4	7.16	8.51	8.82	10.68	19.20	7.60	8.00	9.15	10.87	20.53
Buckwheat No. 5	6.20	6.64	6.28	8.49	20.51	5.54	5.88	5.71	8.34	18.33
Other [2]	4.14	4.04	4.81	5.18	6.25	3.68	3.50	4.70	5.83	8.41
Total buckwheat No. 1 and smaller	8.51	9.78	10.09	11.55	23.78	8.77	9.39	9.43	10.66	17.76
Total all sizes	10.74	12.10	12.35	14.09	26.45	10.72	11.40	11.48	12.67	20.81
	Wyoming region [3]					Total				
Lump [1] and broken	--	--	--	--	--	--	$6.00	--	--	--
Egg	$15.62	$19.29	$18.46	$19.88	$30.46	$14.93	17.76	$18.11	$19.55	$32.91
Stove	16.00	16.67	18.13	20.08	29.95	15.41	16.65	17.73	19.51	31.54
Chestnut	16.75	17.56	18.63	20.36	28.40	15.67	16.79	17.66	19.30	31.06
Pea	14.83	16.30	16.38	17.82	25.56	13.87	15.28	15.72	16.98	27.61
Total pea and larger	15.93	16.96	17.81	19.42	28.10	15.06	16.39	17.18	18.76	30.41
Buckwheat No. 1	13.62	15.15	16.23	17.46	28.02	13.26	14.83	15.38	16.60	28.36
Buckwheat No. 2 (rice)	13.77	15.17	15.60	17.93	27.57	13.14	14.56	15.12	16.77	26.73
Buckwheat No. 3 (barley)	11.07	13.13	13.87	13.91	21.92	11.06	12.56	12.97	14.11	23.16
Buckwheat No. 4	7.16	7.78	9.39	10.40	14.48	7.40	8.07	9.11	10.78	19.35
Buckwheat No. 5	4.41	6.61	7.22	8.96	14.01	5.65	6.08	5.93	8.39	18.82
Other [2]	4.50	6.24	6.60	7.15	10.66	4.00	4.44	5.16	5.78	8.77
Total buckwheat No. 1 and smaller	9.56	11.50	12.71	13.85	16.51	8.92	9.90	10.14	11.30	18.88
Total all sizes	12.09	13.70	14.94	16.33	20.11	11.03	12.08	12.40	13.65	22.19

[1] Quantity of lump included is insignificant.
[2] Includes various mixtures of buckwheat Nos. 2 to 5 and coal of relatively low dollar value.
[3] Includes Sullivan County.

Table 18.—Average value of Pennsylvania anthracite from all sources, by region [1]

(Per net ton)

Region	1973				1974			
	Shipped by rail	Shipped by truck	Colliery fuel	Total	Shipped by rail	Shipped by truck	Colliery fuel	Total
Lehigh	$15.46	$12.72	$16.31	$14.10	$27.11	$25.79	$26.05	$26.45
Schuylkill	11.75	12.29	14.01	12.05	23.84	18.71	22.53	20.36
Wyoming [2]	16.26	16.35	16.39	16.33	22.27	19.28	21.95	20.11
Total	13.30	13.15	15.11	13.22	24.85	20.18	23.64	21.87

[1] Value given for shipments is that at which coal left possession of producing company; does not include selling expenses.

[2] Includes Sullivan County.

Table 19.—Wholesale prices of Pennsylvania anthracite in 1974, by size [1]

(Per net ton)

Size	Winter	Spring	Summer-fall	End of year
Egg and stove	$22.50–23.50	$23.50–24.50	$33.50–33.00	$42.50–43.00
Chestnut	21.75–22.50	23.00–23.75	32.00–32.25	42.50–42.75
Pea	19.50–19.60	20.50–20.60	27.50–27.75	37.50
Buckwheat No. 1	19.50–19.60	20.50–20.60	27.50–27.75	37.50
Buckwheat No. 2 (rice)	19.50–19.60	20.50–23.50	27.50	37.50
Buckwheat No. 3 (barley)	18.50	19.50	26.50	36.50

[1] As quoted in the Black Diamond Magazine. All prices are per short ton f.o.b. at mines.

Table 20.—Employment at operations producing Pennsylvania anthracite (including strip contractors) in 1974

	Lehigh region	Schuylkill region	Wyoming region [1]	Total	
				1974 [p]	1973
Average number working daily:					
Underground	NA	NA	NA	594	716
Strip	NA	NA	NA	1,376	1,633
Culm banks	NA	NA	NA	390	327
Preparation plants	NA	NA	NA	1,366	1,214
Other surface	NA	NA	NA	101	143
Total excluding dredge operations	NA	NA	NA	3,827	4,033
Dredge operations	NA	NA	NA	20	50
Total	NA	NA	NA	3,847	4,083
Average number of days active:					
All operations except dredges	NA	NA	NA	218	233
Dredge operations	NA	NA	NA	300	300
Average, all operations	NA	NA	NA	219	234
Man-days of labor:					
All operations except dredges	NA	NA	NA	834,000	940,000
Dredge operations	NA	NA	NA	6,000	15,000
Total, all operations	NA	NA	NA	840,000	955,000
Average tons per man-day:					
All operations except dredges	NA	NA	NA	7.75	6.80
Dredge operations	NA	NA	NA	25.08	29.41
Average, all operations	NA	NA	NA	7.87	7.15

[p] Preliminary. NA Not available.

[1] Includes Sullivan County.

Table 21.—Distribution of Pennsylvania anthracite, calendar year 1974, by State, Province, and country of destination

(Net tons)

Destination	Pea and larger					Buckwheat No. 1 and smaller					Total, all sizes
	Broken and egg	Stove	Chestnut	Pea	Total	Buckwheat No. 1	Buckwheat No. 2 (rice)	Buckwheat No. 3 (barley)	Other	Total	
United States:											
New England States:											
Connecticut	540	1,496	3,802	120	5,958	552	250	5	121	928	6,886
Maine	--	1,430	2,905	4	4,339	80	1,106	2	10	1,198	5,537
Massachusetts	626	10,242	10,171	873	21,912	659	2,180	1	1,493	4,333	26,245
New Hampshire	--	1,847	1,897	30	3,774	200	183	--	154	537	4,311
Rhode Island	178	703	939	57	1,872	--	--	--	62	62	1,934
Vermont	202	2,412	2,499	410	5,523	507	2,853	--	--	3,360	8,883
Total	1,541	18,130	22,213	1,494	43,378	1,998	6,572	8	1,840	10,418	53,796
Middle Atlantic States:											
New Jersey	3,702	15,097	34,345	6,155	59,299	4,507	4,127	259	46,032	54,925	114,224
New York	6,262	75,701	63,004	107,966	252,933	92,221	31,765	69,323	185,667	378,976	631,909
Pennsylvania[1]	27,955	185,100	314,318	258,870	786,243	296,222	465,159	436,730	1,410,321	2,608,432	3,394,675
Total	37,919	275,898	411,667	372,991	1,098,475	392,950	501,051	506,312	1,642,020	3,042,333	4,140,808
South Atlantic States:[2]											
Delaware	772	2,465	3,619	1,183	8,039	192	50	2,412	17	2,671	10,710
District of Columbia	--	1,359	1,442	545	3,346	493	76	--	191	760	4,106
Maryland	115	6,995	5,628	5,974	18,712	633	244	118	32,251	33,246	51,958
Virginia	1,532	1,392	1,031	68	4,023	747	1,164	1,509	1,167	4,587	8,610
West Virginia	--	--	8	15,598	15,606	17	4	15	41,059	41,095	56,701
Total	2,419	12,211	11,728	23,368	49,726	2,082	1,538	4,054	74,685	82,359	132,085
Lake States:											
Illinois	360	196	3,097	10,954	14,607	34,466	11,580	2,370	12,772	61,188	34,110
Indiana	--	308	191	3,471	3,970	51	127	2,188	27,779	30,140	75,795
Michigan	843	59,798	22,639	26,104	109,384	1,343	179	27	9,772	11,321	120,705
Minnesota	--	89	1	1	91	3	--	3	10,593	10,599	10,690
Ohio	2,889	6,365	10,208	2,370	21,832	18,847	5,550	280	54,810	79,487	101,319
Wisconsin	50	3,430	1,111	69	4,660	25	28	727	1,106	1,886	6,546
Total	4,142	70,186	37,247	42,969	154,544	54,735	17,464	5,590	116,832	194,621	349,165
Other States	471	4	452	15,485	16,412	81,181	7,132	19,157	267,027	374,497	390,909
Total United States	46,492	376,429	483,307	456,307	1,362,535	532,946	533,757	535,121	2,102,404	3,704,228	5,066,763

Canada:											
Ontario	1,167	29,044	24,948	4,365	59,524	20,712	1,209	1,862	14,482	38,265	97,789
Quebec	159	1,632	1,343	71	3,205	27,222	420	145,117	206,862	379,621	382,826
Other Provinces	--	226	61	1	288	257	60	1	124	442	730
Total Canada	1,326	30,902	26,352	4,437	63,017	48,191	1,689	146,980	221,468	418,328	481,345
Other countries	65,775	190,968	119,346	44,099	420,188	12,298	4,228	1,272	ᵖ 250,137	ᵖ 267,935	ᵖ 688,123
Grand total	113,593	598,299	629,005	504,843	1,845,740	593,435	539,674	688,373	2,574,009	4,390,491	6,286,231

ᵖ Preliminary.

[1] Includes "Local sales."

[2] Shipments to other States in the South Atlantic area are included in "Other States."

Table 22.—Truck shipments of Pennsylvania anthracite in 1974, by month, and by State of destination [1]

(Thousand short tons)

Destination	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total	Percent of total trucked
Pennsylvania:														
Within region	133	115	111	96	87	92	108	125	120	151	142	130	1,410	36.0
Outside region	196	136	126	169	134	193	149	154	182	158	195	151	1,943	49.6
New York	31	33	34	36	35	23	28	35	31	41	45	44	416	10.6
New Jersey	9	7	7	8	7	6	5	4	5	6	7	6	77	2.0
Delaware	1	1	2	1	2	1	1	1	(2)	(2)	(2)	1	11	.2
Maryland	3	2	1	2	3	3	2	3	3	4	3	1	30	.8
Other States	2	1	1	(2)	3	7	2	4	3	2	2	3	30	.8
Total: [1]														
1974	375	295	281	313	271	325	295	326	344	362	394	336	3,917	100.0
1973	367	379	310	267	314	267	226	323	292	360	380	286	3,771	100.0

[1] Compiled from reports of Pennsylvania Department of Mines and Mineral Industries; does not include dredge coal.
[2] Less than ½ unit.

Table 23.—Shipments of Pennsylvania anthracite, by destination [1]

(Thousand short tons)

Destination	1970	1971	1972	1973	1974
TRUCK SHIPMENTS					
Pennsylvania:					
Within region	1,847	1,880	1,584	1,511	1,410
Outside region	1,979	2,050	1,793	1,758	1,943
New York	418	373	441	380	416
New Jersey	198	126	89	77	77
Delaware	18	17	15	11	11
Maryland	50	29	23	26	30
District of Columbia	2	(2)	(2)	--	--
Other States	15	12	21	8	30
Total	4,527	4,487	3,966	3,771	3,917
RAIL SHIPMENTS					
New England States	102	100	49	45	37
New York	455	532	281	299	187
New Jersey	173	113	85	55	34
Pennsylvania	847	819	830	856	679
Delaware	1	1	5	(2)	(2)
Maryland	19	24	2	1	23
District of Columbia	7	3	3	2	3
Virginia	9	7	3	8	15
Ohio	151	122	124	122	77
Indiana	66	54	42	43	34
Illinois	93	57	47	56	61
Wisconsin	12	8	10	8	6
Missouri	--	--	30	26	30
Minnesota	51	1	10	11	28
Iowa	--	--	31	36	47
Michigan	53	70	49	98	72
Other States	408	455	290	311	316
Total United States	2,447	2,366	1,891	1,977	1,649
Canada	384	411	386	389	348
Other countries	691	572	374	384	327
Grand total	3,522	[3] 3,349	2,651	2,750	2,324

[1] Compiled from reports of Pennsylvania Department of Mines and Mineral Industries; does not include dredge coal.
[2] Less than ½ unit.
[3] Corrected figure; erroneously reported in years 1971 and 1972.

Table 24.—Consumption of Pennsylvania anthracite in the United States, by consumer category

(Thousand short tons)

Year	Residential and commercial heating [e]	Colliery fuel	Electric utilities [1]	Cement plants	Iron and steel Industry		Other uses [e]
					Coke making	Sintering and pelletizing [2]	
1970	4,042	16	1,897	W	472	464	1,357
1971	3,850	15	1,646	W	421	339	1,037
1972	2,960	11	1,584	W	474	283	603
1973	2,917	11	1,442	W	467	231	603
1974	2,577	12	1,498	W	444	367	550

[e] Estimate. W Withheld to avoid disclosing individual company confidential data; included in "Other uses."

[1] Federal Power Commission data.

[2] Annual Statistical Report, American Iron and Steel Institute.

Table 25.—U.S. exports of anthracite, by country and customs district

	1973		1974	
	Quantity (short tons)	Value (thousands)	Quantity (short tons)	Value (thousands)
COUNTRY				
Argentina	2,216	$28	--	--
Australia	2,373	156	27,347	$482
Brazil	2,475	175	1,459	121
Canada	477,692	6,897	481,345	9,772
Chile	4,712	61	4,195	124
Colombia	512	14	3	1
Denmark	279	3	--	--
Dominican Republic	545	7	12	1
Finland	532	9	60	4
France	105,511	1,500	165,966	3,700
India	4,257	136	4	1
Indonesia	653	8	--	--
Iran	122	12	905	67
Italy	28,008	395	18,470	588
Korea, Republic of	260	3	773	29
Mexico	8,303	240	10,317	412
Netherlands	39,221	543	11,341	366
Panama	--	--	649	62
Philippines	1,213	45	1,541	127
Surinam	250	17	414	35
Sweden	9,604	214	3,271	265
Venezuela	26,796	748	4,212	231
Vietnam, South	--	--	1,595	142
Other	1,012	29	1,294	52
Total	716,546	11,240	735,173	16,577
CUSTOMS DISTRICT				
Baltimore	2,207	154	23,514	551
Buffalo	83,506	1,746	128,260	3,120
Detroit	12,477	188	7,871	191
Galveston	--	--	23	1
Houston	--	--	197	7
Laredo	7,762	231	10,317	412
Miami	179	3	11	12
Mobile	12	1	152	17
New Orleans	3,457	250	6,280	394
New York City	3,028	91	3,519	244
Ogdensburg	27,220	525	45,062	1,028
Pembina	3,181	60	1,697	88
Philadelphia	571,603	7,921	505,775	10,394
Port Arthur	1,045	65	--	--
Portland, Maine	--	--	139	2
San Francisco	--	--	1,407	104
Savannah	--	--	184	3
St. Albans	355	4	--	--
Seattle	564	6	765	14
Total	716,546	11,240	735,173	16,577

Table 26.—Anthracite:[1] World production, by country

(Thousand short tons)

Country[2]	1972	1973	1974[p]
Belgium	3,258	2,759	2,247
Bulgaria	171	141	[e] 130
China, People's Republic of[e]	22,000	22,000	28,000
France	9,353	7,816	6,586
Germany, West	8,793	7,455	7,617
Ireland[e]	22	22	28
Japan	504	239	154
Korea, North[e]	30.100	33,100	36,400
Korea, Republic of	13,672	14,959	16,825
Morocco	603	623	633
Netherlands	[r] 3,243	2,016	906
Peru	32	[r] [e] 33	[e] 33
Portugal	278	301	254
Romania[e]	16	16	22
South Africa, Republic of	1,473	1,552	1,782
Spain	3,312	3,292	3,224
U.S.S.R	83,133	84,253	[e] 87,100
United Kingdom	[r] 3,794	3,697	[e] 3,300
United States (Pennsylvania)	7,106	6,830	6,617
Vietnam, North[e]	2,200	3,300	4,400
Total	[r] 193,068	194,404	206,258

[e] Estimate. [p] Preliminary. [r] Revised.

[1] An unspecified amount of semianthracite is included in figures for some countries.

[2] In addition to the countries listed, Canada, Colombia, New Zealand, and South Vietnam produce anthracite, but the level of production is not recorded, and available information is inadequate to make reliable estimates; in Colombia output may total 100,000 tons annually; in New Zealand and South Vietnam output is insignificant.

Cobalt

By Scott F. Sibley[1]

Demand for cobalt was relatively high during most of 1974, but began to slacken during the last quarter in line with general industrial activity. Cobalt-bearing salts and driers, magnetic materials, and superalloys were in greatest demand during the year. Consumer stocks at yearend were slightly below their 1973 yearend level. Government releases of cobalt from the strategic stockpile were again a significant source of supply during 1974, with over 8.5 million pounds released.

Legislation and Government Programs.—The General Services Administration (GSA) continued to offer specification-grade cobalt metal in various forms for sale during 1974. Sales were on an unrestricted-bid basis except that total sales of specification-grade material were limited to about 1 million pounds per month and 500,000 pounds per bidder per month. The stockpile objective for cobalt remained at 11,945,000 pounds in 1974. As of December 31, 1974, total U.S. Government stockpile inventory was 53,994,682 pounds of specification-grade cobalt. Government sales of cobalt for the year totaled 8,649,811 pounds, compared with 7,500,589 pounds in 1973.

Table 1.—Salient cobalt statistics
(Thousand pounds of contained cobalt)

	1970	1971	1972	1973	1974
United States:					
Consumption	13,367	12,500	14,130	18,741	18,861
Imports for consumption	12,417	10,912	18,915	r 19,201	15,878
Stocks, Dec. 31: Consumer	1,890	1,411	1,198	2,451	2,047
Price: Metal, per pound	$2.20	$2.20–$2.45	$2.45	$2.45–$3.10	$3.10–$3.75
World: Production, mine	52,590	54,598	r 54,752	r 58,536	67,008

r Revised.

DOMESTIC PRODUCTION

There was no domestic mine production of cobalt in 1974. However, Amax Nickel, Inc. completed renovation of its nickel-cobalt refinery, at Port Nickel, La. The plant became operational in late 1974 and was expected to produce about 1.2 million pounds of cobalt annually for markets in the United States and Europe. Botswana and other foreign sources will supply the refinery with a nickel-copper matte. Capacity was reported at 5 million pounds of cobalt per year.

A Tenneco Inc., subsidiary, Deep Sea Ventures, Inc. of Gloucester Point, Va., and three Japanese trading firms signed an agreement to evaluate and develop a Pacific Ocean site in order to mine cobalt-bearing manganese nodules from the sea floor. A similar venture was announced in February by a multinational consortium which included Kennecott Copper Corp. (KCC). The Tenneco project in its initial 3-year phase would cost an estimated $20 million; up to $200 million could be expended if the project were considered economically feasible and ores were marketed. Recovery of nodules from depths in excess of 2.5 miles would be made by Deep Sea Ventures.

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CONSUMPTION AND USES

Consumption of cobalt in the United States in 1974 was 18.9 million pounds, 0.6% above that of 1973. The decline in the rate of consumption was a direct result of a general slackening of industrial activity throughout the economy. The pattern of cobalt consumption was little changed from that of 1973, with major consumption occurring in salts and driers, magnetic materials, superalloys, and cutting and wear-resistant materials. Consumption of cobalt in catalysts again registered a marked increase. Data reported by consumers showed that of the cobalt consumed in the United States in 1974, 77% was as metal, 19% was as salts and driers, 3% was as oxide, and 1% was as purchased scrap.

The market for rare-earth cobalt magnets expanded in 1974 and competed with conventional Alnico magnets in certain applications. Raytheon Co. manufactured a new samarium-cobalt alloy which, once magnetized, reportedly will hold its magnetism even though exposed to extremely high demagnetizing fields. According to company officials, diverse and complex shapes may be readily produced by the company's sintering method, thus limiting the amount of machining required. The magnetized material was reported to have an intrinsic coercive force greater than that of any other material available (1974).[2] To handle increased production of samarium and other rare-earth cobalt magnets, Raytheon reportedly installed a large sintering furnace at its Waltham, Mass., facility.[3] General Electric Research and Development Center developed and tested prototypes of what was reportedly the world's first bearingless aircraft tachometer generator. The generator contained a cobalt-samarium permanent magnet with a reported maximum energy product of over 25 million gauss-oersteds.[4]

Hitachi Metals, Ltd. introduced a new alloy termed "H-Aloy." This new corrosion- and wear-resistant cobalt-base alloy reportedly joins with the metal being coated in the centrifugal casting process to form a bimetallic coating with an average Shore hardness of 70 to 80. The patented material reportedly can be used for plastics injection molding, extrusion machinery, reciprocative pump machinery and cylinders, and oil drilling equipment.[5]

One innovative application for cobalt was a diverter valve part for auto emission systems in 1975 cars. The part is made of Dupont Tribaloy 480, which is 62% cobalt and can withstand temperatures of at least 1,500° F. However, the quantity used was only about 20 grams per car, totaling 20,000 to 25,000 pounds in 1975 cars.[6]

New Jersey Zinc Co. developed a new cobalt-brass alloy powder that was reportedly an improvement over conventional 70–30 leaded brass powder. According to company officials, fabricators can now attain ultimate tensile strengths up to 43,500 pounds per square inch, yield strengths of 33,200 pounds per square inch, and hardness of 100 R_h. Parts made from the new powder also undergo less dimensional change.[7]

The cemented carbide industry reportedly experienced a 15% to 20% growth rate during the year. Significant gains were recorded in cobalt-bearing wear-resistant components, cutting and metalworking tools, and mining and construction equipment.

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[2] Financial Times. Holds Its Magnetism. No. 26,390, June 18, 1974, "The Technical Page."

[3] American Metal Market. Raytheon Installs Sintering Furnace To Make Rare-Earth Cobalt Magnets. V. 81, No. 45, Mar. 6, 1974, p. 11.

[4] Cobalt in Industry. Cobalt Magnets Eliminate Generator Bearings. Cobalt Information Center, Columbus, Ohio. No. 4, 1974, p. 1.

[5] American Metal Market. 'H-Aloy' Patented by Hitachi Metals. V. 81, No. 129, July 3, 1974, p. 5A.

[6] American Metal Market. Long-Term Outlook: Greater Consumption. V. 81, No. 148, July 31, 1974, p. 1.

[7] Iron Age. New Cobalt-Brass Powder Gives Parts Boost in Properties. V. 213, No. 4, Jan. 28, 1974, p. 17.

Table 2.—Cobalt materials consumed by refiners or processors in the United States

(Thousand pounds of contained cobalt)

Form [1]	1970	1971	1972	1973	1974
Alloy and concentrate	274	356	120	14	--
Metal	2,639	2,899	3,063	4,028	4,754
Hydrate	32	18	16	60	46
Other	9	9	16	26	153

[1] Total consumption is not shown because some metal and hydrate originated from alloy and concentrate, and a total would involve duplication.

Table 3.—Cobalt products[1] produced and shipped by refiners and processors in the United States

(Thousand pounds)

	1973				1974			
	Production		Shipments		Production		Shipments	
	Gross weight	Cobalt content	Gross weight	Cobalt content	Gross weight	Cobalt content	Gross weight	Cobalt content
Oxide	880	622	1,161	819	1,029	731	894	634
Hydrate	1,021	631	1,036	640	1,265	782	1,015	628
Salts[2]	8,503	1,944	8,373	1,962	8,556	2,070	8,328	1,973
Driers	11,002	922	11,589	967	12,443	1,053	12,238	1,034
Total	21,406	4,119	22,159	4,388	23,293	4,636	22,475	4,269

[1] Figures on metal withheld to avoid disclosing individual company confidential data.
[2] Combined to avoid disclosing individual company confidential data.

Table 4.—Cobalt consumed in the United States, by end use

(Thousand pounds of contained cobalt)

Use	1974
Steel:	
Carbon	5
Stainless and heat resisting	39
Full alloy	249
High-strength, low-alloy	8
Electric	W
Tool	690
Cast irons	W
Superalloys	4,090
Alloys (excludes alloy steels and superalloys):	
Cutting and wear-resistant materials[1]	2,578
Welding and alloy hard-facing rods and materials	423
Magnetic alloys	3,457
Nonferrous alloys	780
Other alloys	639
Mill products made from metal powder	W
Chemical and ceramic uses:	
Pigments	192
Catalysts	1,378
Ground coat frit	133
Glass decolorizer	51
Other	151
Miscellaneous and unspecified	363
Total	15,226
Salts and driers: Lacquers, varnishes, paints, ink, pigments, enamels, glazes, feed, electroplating, etc	3,635
Grand total	18,861

W Withheld to avoid disclosing individual company confidential data; included in "Miscellaneous and unspecified."
[1] Includes cemented and sintered carbides and cast carbide dies or parts.

Table 5.—Cobalt consumed in the United States, by form

(Thousand pounds of contained cobalt)

Form	1970	1971	1972	1973	1974
Metal	10,056	9,006	10,509	r 14,240	14,420
Oxide	626	625	733	668	536
Purchased scrap	69	125	197	r 264	270
Salts and driers	2,616	2,744	2,691	3,569	3,635
Total	13,367	12,500	14,130	18,741	18,861

r Revised.

PRICES

The producer price of $3.10 per pound for cobalt metal granules (shot) or broken cathodes in 551-pound (250-kilogram) drums was increased to $3.45 per pound on May 16, and to $3.75 per pound on July 8. The price remained at that level until January 23, 1975, when it was raised again, to $4.00 per pound, f.o.b. New York or Chicago. A weighted average price for the year was calculated to be $3.46 per pound of cobalt.

Sales of cobalt metal by the Government on a "sealed-bid" basis ranged in price from $2.745 to $3.611 per pound for specification-grade material. All prices were f.o.b. carrier's conveyance at Government storage locations.

FOREIGN TRADE

Exports of unwrought cobalt metal and alloys and of waste and scrap totaled 2,209,010 pounds, gross weight, having a value of $4,664,456, and went to 24 countries. West Germany and France received the greater part, with 1,286,088 pounds ($3,533,672) and 668,660 pounds ($1,747,303), respectively. Exports of wrought cobalt metal and alloys, 1,469,831 pounds, gross weight, having a value of $6,314,745, went to 16 countries. There were insignificant imports of salts and compounds in 1974.

Table 6.—U.S. imports for consumption of cobalt metal and oxide, by country
(Thousand pounds and thousand dollars)

Country	Metal				Oxide			
	1973		1974		1973		1974	
	Gross weight	Value	Gross weight	Value	Gross weight	Value	Gross weight	Value
Australia	5	5	1	2	--	--	--	--
Belgium-Luxembourg	r 4,247	r 13,762	4,180	15,665	847	2,158	1,472	4,401
Canada	502	1,458	215	770	228	355	--	--
Dominican Republic	23	74	--	--	--	--	--	--
Finland	909	2,850	861	3,088	--	--	--	--
France	197	r 405	272	633	--	--	--	--
Germany, West	39	76	55	99	--	--	36	109
Greece	--	--	5	9	--	--	--	--
Italy	45	88	--	--	--	--	--	--
Japan	5	6	--	--	--	--	(1)	(1)
Liberia	--	--	--	--	--	--	--	--
Mexico	--	--	6	7	--	--	--	--
Netherlands	16	27	16	28	--	--	--	--
Norway	972	2,995	1,320	4,261	--	--	--	--
Switzerland	--	--	50	77	--	--	1	4
Taiwan	55	224	--	--	75	201	--	--
United Kingdom	187	228	228	376	--	--	--	--
Zaire	11,196	31,684	7,468	24,292	--	--	--	--
Zambia	--	--	114	354	--	--	--	--
Total	r 18,398	r 53,772	14,791	49,661	1,150	2,714	1,509	4,514

r Revised.
[1] Less than ½ unit.

Table 7.—U.S. imports for consumption of cobalt, by class
(Thousand pounds and thousand dollars)

Year	Metal		Oxide		Salts and compounds		Total	
	Gross weight	Value	Gross weight	Value	Gross weight	Value	Gross weight	Cobalt content e
1972	13,082	30,650	1,134	2,330	82	44	14,298	13,915
1973	r 18,398	r 53,772	1,150	2,714	r 62	r 51	r 19,610	r 19,201
1974	14,791	49,661	1,509	4,514	2	12	16,302	15,878

e Estimate. r Revised.

WORLD REVIEW

Supplemented by U.S. Government stockpile releases, cobalt production in market economy countries was sufficient to meet demand in 1974. Zaire again led all countries in mine production of cobalt and accounted for 58% of the total world output. Cobalt production in 1974 increased in all major producing countries except Cuba and Finland, compared with that of 1973.

The United Nations Law of the Sea Conference was held in Caracas, Venezuela, in August. No treaty emerged from the meeting, which lasted 10 full weeks and was attended by representatives from 150 countries. Another conference was scheduled for Geneva in the spring of 1975. In spite of delays in obtaining a treaty, several companies and international consortiums were actively engaged in development and exploration of ocean floor mineral deposits. These included Kennecott Copper Corp.; Deep Sea Ventures; and International Nickel Co. of Canada, Ltd. (INCO). All three had invested more than $100 million in ocean mining technology. Countries involved in ocean mining included the United States, Canada, the United Kingdom, France, Japan, and West Germany. A joint company, Ocean Mining Associates, was formed to develop a 1.49 million tons-per-year (wet) manganese nodule mining operation over a 3-year period. A 37,200-square-mile area 1,000 miles off the tip of Baja California was expected to yield 2,767 tons per year of cobalt when mining equipment becomes fully operational.

Australia.—At Greenvale, late in 1974, Queensland Mines Limited began production of 650 tons per year of cobalt metal and 3,900 tons per year of mixed nickel-cobalt sulfides. The operation was a joint project of Metals Exploration Queensland Pty., Ltd., and Freeport Queensland Nickel, Inc. The laterite ore at the site was estimated to contain 45 million short tons of cobalt grading 0.12% cobalt.

Canada.—Production of cobalt in Canada totaled 4,240,000 pounds in 1974, up 27% over that of 1973. INCO was expected to negotiate labor contracts in 1975, but there was no indication of the position either side would take. Falconbridge Nickel Mines Ltd., which had planned to build a nickel-cobalt refinery at Becancour, Quebec, abandoned the project at least for the immediate future. The projected capacity of the refinery was to be 250 tons of cobalt per year. Mitsui Mining Co. and Copperfield Mining Co. were considering a cobalt-mining venture at Chicoutimi, Quebec. Mitsui was to provide the financing. Sherritt Gordon Mines Ltd., reportedly increased its imports of concentrates from Australia. The company also received concentrates from its Lynn Lake mine in Manitoba for processing at the Fort Saskatchewan refinery in Alberta.

Cuba.—Cuba planned to triple its nickel production by 1985, according to Angel Gomez Trubeda, Cuban Minister of Industrial Development. Presumably cobalt production would be increased as well, since Cuban ore also contains recoverable cobalt. Cuba produced about 3,600,000 pounds of cobalt in 1973, most of which was exported to the Soviet Union, Czechoslovakia, Romania, France, the United Kingdom, Italy, and Japan, with the Soviet Union receiving about 50% of the total.

India.—Work on India's first nickel-cobalt plant at Sukinda near Cuttack began in April 1974 and was scheduled for completion in 1978. The project was a joint venture of Orissa State and the Central Government and was estimated to cost $47 million. The deposits, located in the Sibunda Valley, were originally thought to contain 15 million tons of nickel ore. There were indications that the deposit might contain as much as 50 million tons of nickel-cobalt ore, which could mean an eventual production of 400 tons of cobalt per year.

Indonesia.—P.T. International Nickel Indonesia, a wholly owned subsidiary of INCO, proceeded with plans to produce a nickel-cobalt matte by 1976. At first a production of 16 million pounds per year of nickel with proportionate amounts of cobalt was expected. Plans being formulated in 1974 called for a severalfold increase in the original capacity.

Japan.—Japan took steps in 1974 to develop a refining capacity for cobalt. By mid-1975, about half of Japan's refined cobalt requirements reportedly will be met internally. Nippon Mining Co. was constructing facilities adjacent to its Hitachi plant and planned to produce about 1,300 short tons per year of cobalt from mixed sulfide ores of the Greenvale mine in Australia. Sumitomo Metal Mining Co. Ltd. planned to produce 1,600 tons per year of cobalt from its Niihama facility using mixed sulfides from the Philippines. According to reports, Sumitomo has already made test runs producing around 100 tons per year of cobalt.

Uganda.—Kilembe Copper Cobalt Ltd. continued work on a feasibility study for a cobalt extraction unit to be constructed at Lasese, Uganda, about 8 miles from the border with Zaire. According to company officials, preliminary data were being gathered in preparation for a detailed plant design. Production at Kilembe was severely hampered in 1973 because of a shortage of experienced supervisory and maintenance personnel.

Zaire.—Progress was made in 1974 toward construction of a 1,054 mile high voltage transmission line from the Inga Dam powerplant on the Congo River to Kolwezi in Shaba Province. A U.S. consortium, headed by Morrison-Knudsen Co., Inc., was awarded a $225 million contract for construction of the line. Scheduled for completion early in 1977, the power facility would have an ultimate capacity of 1,020-megawatts and allow further development of the vast resources of Shaba Province. Moreover, the transmission line will be tied in with an existing power generation and distribution network linked with nearby Zambia.

A principal beneficiary of the Inga-Shaba power project is the Société de Minière de Tenke Fungurume (SMTF), which is 20% owned by the Zaire Government. Others with interests in SMTF include Leon Tempelsman and Sons, Inc., of New York, Amoco Minerals Co. (United States), Mitsui Mining Co. (Japan), and two French groups, Bureau de Recherches Géologiques et Minières, and Omnium des Mines. SMTF owns a concession covering 577 square miles in Shaba Province. One feasibility study indicated reserves of 54 million tons of mixed sulfide ore grading 0.46% total cobalt. Processing facilities as well as a townsite were to be constructed at Fungurume, about 9 miles from Tenke, where the mining operations were to be established. Annual production of 6,000 tons of byproduct cobalt was anticipated when the facilities become operational. Cobalt production was to coincide with completion of the Inga-Shaba powerline in 1977. Fluor Utah Inc. of San Mateo, Calif., was awarded a contract for engineering of the ore processing facilities, from crushing through electrowinning, and was also to be responsible for procurement of equipment and construction. At yearend Fluor Utah had obtained complete financing for the $125 million of U.S. goods required for the project. The financing was obtained from SMTF, the Export Import Bank, and a consortium of banks led by Chase Manhattan Bank, New York.

An agreement was reached in April between the Zaire Government and the Belgian company Société Générale des Minerais (SGM), whereby the marketing and trading operations that SGM controlled were to be transferred to a Zairian firm. At the same time, an agreement was also reached on compensation by Zaire to SGM and associated companies for assets expropriated in 1967.

Générale des Carrière et des Mines (GECAMINES) embarked on an expansion program designed to increase its cobalt production by about 4,400 short tons by 1978. Zaire produced 19,340 short tons of cobalt in 1974. GECAMINES obtained a major loan at yearend to help finance the $435 million expansion of its copper and cobalt mining and refining capacity. The Libyan Arab Foreign Bank, European Investment Bank, and World Bank were to provide loans totaling $220 million; the balance was to be paid by GECAMINES itself. Plans for the project, located at Kolwezi in Central Shaba Province, included the development of two new open pit mines with attendant treatment facilities. These consisted of a concentrator, and a smelter and refinery of 100,000 tons' capacity each. In spite of these expansions, Zaire planned to hold production to about 17,000 short tons in 1975 and 1976 to avoid flooding the cobalt market. The ore extracted from the two new mines was to be processed in a DIMA concentrator. In addition, a flash smelting plant with ancillary cobalt treat-developments were part of GECAMINES' second 5-year expansion plan, which was to begin in 1975.

Zambia.—The Zambian Government obtained controlling interest (51%) in the country's major mining groups, Roan Consolidated Mines Ltd. (RCM) and Nchanga Consolidated Copper Mines Ltd. (NCCM). However, management and sales were left in private hands until contracts expire in 1979. Anglo American Corp. and American Metal Climax Inc. negotiated with the Zambian Government for the new articles of association, which were part of Zambia's general plan to assume management of its mining operations.

Exports from Zambia were shipped from the ports of Dar es Salaam in Tanganyika and Lobito in Angola, where the shipments reportedly were given priority. Zambia's border with Rhodesia remained closed during 1974.

Table 8.—Cobalt: World production by country
(Short tons)

Country	Mine output, metal content[1]			Metal[2]		
	1972	1973	1974 [p]	1972	1973	1974 [p]
Australia	[r] 849	848	[e] 850	--	--	--
Botswana	--	[e] 1	[e] 12	--	--	[e] 9
Canada[3]	1,676	1,672	2,120	1,323	667	1,073
Cuba [e]	1,700	1,800	1,800	--	--	--
Finland	[e] 1,400	[e] 14,00	[e] 1,400	885	1,113	895
France[4]	--	--	--	853	922	[e] 1,000
Germany, West[4]	--	--	--	504	408	392
Japan	--	--	--	--	--	12
Morocco	1,766	1,567	1,932	--	--	--
Norway	NA	NA	NA	[5] 353	[5] 1,005	[e] [5] 1,100
Philippines [e]	45	45	660	--	--	--
U.S.S.R.[e] [6]	1,800	1,850	1,900	1,800	1,850	1,900
Zaire	14,453	16,625	[7] 19,340	14,377	16,592	19,340
Zambia	3,687	[e] [r] 3,460	[e] 3,490	2,263	2,143	2,163
Total	[r] 27,376	29,268	33,504	22,358	24,700	27,884

[e] Estimate. [p] Preliminary. [r] Revised. NA Not available.

[1] In addition to the countries listed, Bulgaria, Cyprus, East Germany, Greece, New Caledonia, Poland, Spain, Sweden, and Uganda are known to produce ores (copper, nickel, and/or pyrite) that contain recoverable quantities of cobalt, but available information is inadequate to make reliable estimates of output levels. Other nations may also produce cobalt as a byproduct component of ores and concentrates of other metals.

[2] In addition to the countries listed, the United Kingdom recovers cobalt metal from intermediate metallurgical products produced in Canada, but data on output are inseparable from the total reported by Canadian producers. Czechoslovakia presumably recovers cobalt from materials imported from Cuba, but data are inadequate to estimate output. Belgium and Japan, both of which import substantial quantities of crude materials containing cobalt, have not recorded output in recent years but are producing metal and/or cobalt compounds. Poland also apparently processes cobalt-bearing copper ores, but no data on cobalt recovery are available.

[3] Actual output not reported. Data presented for mine output are total cobalt content of all products, including nickel oxide sinter shipped to the United Kingdom for further processing and nickel-copper matte shipped to Norway for further processing. Data presented for metal output are total cobalt content of all products less cobalt output recorded for Norway. Thus, the metal data include cobalt content of oxides and other compounds that are not produced as metal and total metal output in the United Kingdom as well as actual metal output in Canada itself.

[4] Domestic mine output, if any, is negligible.

[5] Produced entirely from nickel-cobalt matte imported from Canada; domestic mine output is recovered abroad.

[6] Insufficient data are available to permit separate estimates for mine and metal production.

[7] Metal output, used in lieu of unreported mine production.

TECHNOLOGY

Bureau of Mines research dealing with cobalt focused on three areas in 1974: Extraction of cobalt from land-based sources; extraction from cobalt-bearing seabed manganese nodules; and rare earth-cobalt magnets. Work was begun at yearend to recover cobalt from primary lead-zinc ores of Missouri, and research continued on the beneficiation of low-grade western laterites to extract cobalt and nickel. Development of a process for economically recovering manganese and associated valuable metals from calcareous Atlantic Ocean nodules of the Blake Plateau also took place. Rare earth-cobalt magnets made of praseodymium-cobalt or mischmetal-cobalt were tested by Bureau researchers. The objective was to develop with these alloys high-performance permanent magnets that could replace the more expensive samarium alloys being used commercially.

The International Workshop on Rare Earth-Cobalt Permanent Magnets, sponsored by the University of Dayton, School of Engineering, was held in October. Discussion topics included raw materials, magnet alloys, magnet manufacture, and device applications.

Many patents were issued in 1974 on all phases of mining activity related to cobalt, from chemical precipitation to alkaline and acid leaching to manganese nodule recovery and extraction of metal values. The greatest number of patents dealt with chemical precipitation and alkaline leaching. In one important area of research, INCO received a British patent (No. 1,359,395) on the extraction of nickel and cobalt values from laterite. By this patented process, ore is divided into limonitic and silicate fractions. The bulk of the nickel and cobalt content is then selectively reduced from the silicate fraction, and the limonitic fraction is pressure-leached with sulfuric acid to yield a leach solution containing nickel and cobalt. The selectively reduced silicate fraction is then mixed with the leach solution, and the resultant slurry is aerated, causing the reduced metal to react with free acid. A pregnant leach solution is produced which is suitable for treatment by conventional techniques.

Several companies experimented with techniques to mine and process cobalt-bearing manganese nodules from the ocean floor; two basic systems were tested. One system involved a sea floor dredge head, which sucks in water and nodules in a huge vacuum operation. The nodules are cleaned and crushed as they are sucked in and then lifted up a several-mile-long pipe to the mining ship. The other system was one in which a series of scoops or buckets are mounted on an extremely long loop of cable. The buckets are hauled to the ship in a continuous dredging process. Chemical processing of the nodules also received much attention. One company operated several pilot plants that used an ammonia leaching process, and one full-scale plant was being designed. Another company used a wet process treatment that reportedly recovered 95% of the metal in the nodules, producing pure sheets of cobalt and other metals. A full-scale operation of this type, designed to process 1 million tons of nodules per year, was anticipated.[8]

Research into high-temperature-resistant alloys by General Electric Co. constituted one possibly significant development. The material developed had the potential for replacing cobalt in certain applications. According to company officials, the silicon carbide composite, with the addition of 1% boron, combines the temperature and corrosion resistance of ceramics with the ductility and high fracture toughness of metals. Because the ceramic material can be cast into component shapes, expensive tooling and machining operations may be avoided.[9] Another superalloy was being developed by Battelle Memorial Institute. The new iron-based alloy contained 16% chrome and 2.6% yttrium oxide and reportedly could be used where currently (1974) only nickel-based and cobalt alloys would perform.[10] Technical papers were presented during 1974 on heat-resisting alloys and composites, cobalt alloy systems and phases, permanent to soft magnetic materials, films and coatings, tool and wear-resisting steels, and alloys and unalloyed coatings and compounds.[11]

Bureau of Mines scientists developed cobalt-molybdenum catalysts which demonstrated excellent activity in the desulfurization of high-sulfur bituminous coal and the hydrocracking of crude shale oil. Conversion of coal to gaseous or liquid fuel is another field in which the growth potential of cobalt-containing catalysts is considered great. In addition, fluidized coal combustion, coal gasification, coal liquefaction, and shale oil retorting facilities will require containment alloys that may be high in cobalt.

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[8] Mining Engineering. The Seabed Power Struggle. V. 26, No. 9, September 1974, p. 42.

[9] American Metal Market. Adding 1% Boron to Silicon Carbide Allows Conventional Forming GE Says. V. 81, No. 29, Feb. 11, 1974, p. 14.

[10] American Metal Market. Alloy Development, Carbon Forms 2 Top Projects at Battelle Labs. V. 81, No. 157, Aug. 13, 1974, p. 19.

[11] Cobalt Information Center, Battelle Memorial Institute (Columbus Ohio). Cobalt. Nos. 1–4, 1974; No. 1, 1975.

Coke and Coal Chemicals

By Franklin D. Cooper [1]

Production of coal coke in the United States in 1974 was 4.3% less than in 1973 because of a coal miners' strike late in the year and a 5.2% decrease in production of pig iron and ferroalloys in blast furnaces. Also contributing to the decrease was a 7.1% smaller demand for foundry coke, and a 24.7% decrease in tonnage of coke shipped to other industrial plants.

Production remained relatively stable throughout the year and averaged 5.13 million tons per month. The average daily output for all plants ranged from a low of 133,000 tons in December to a high of 179,900 tons in February. Average daily output for the year averaged 168,700 tons.

During July and throughout the fourth quarter, demand for coke exceeded production primarily because of interruptions in coal deliveries. Accordingly, producers' stocks of oven coke were 21% lower at the end of the year than 1 year earlier.

Blast furnaces continued to use the bulk of the Nation's coke production, receiving 91.6% of the 61.6 million tons of coke distributed by producers. However, consumption of coke per ton of hot metal produced at blast furnaces increased 18 pounds despite a net overall increase over 1973 in coke equivalent of fuels injected through blast furnace tuyeres, which amounted to 281,840 Btu or 21.7 pounds of coke equivalent per ton of hot metal.

Breeze production per ton of coal increased 8.5% (9 pounds) because of the use of some marginal-quality coking coals, the slightly reduced use of low-volatile coals in the mixtures carbonized, and generally longer coking time late in the year. Breeze is unsuitable for most metallurgical applications because of its small size and high-volatile and ash contents. The larger part of the breeze production was used by producers for sintering iron ores and for other industrial purposes. However, 45% of the output was sold, mainly for use as a reductant in electric furnaces producing elemental phosphorus. Tonnage of breeze sold was 6.7% more than in 1973 and brought an average of $17.83 per ton, up from $10.39 in 1973.

The average delivered value of all coals, including anthracite, carbonized in slot ovens, increased 97.1% and averaged $36.49 per ton. This increase was reflected directly in average coke prices, which increased 53% to $65.74 per ton. The largest price increase occurred in sales of coke to foundries. Foundry coke prices, which averaged $78.92 per ton, f.o.b. plant, were 44% higher than in 1973.

Production of tars, ammonia, light oil, and coke-oven gas decreased because less coal was carbonized.

Foreign trade was relatively active with coke exports at 1.28 million tons, about 2.1% of domestic production. The bulk of the exported coke was shipped to Canada, Mexico, and West Germany. Coke imports were 228% greater in 1974, but exports were down 8.4%.

The total value of all coals carbonized in slot ovens was $3,242 million, and the total value of all products of carbonization was $5,262 million. The combined value of coke and breeze, the principal products, accounted for 87.6% of the total value of all products.

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COKE AND BREEZE

DOMESTIC PRODUCTION

A substantial decrease in the production of pig iron and ferroalloys in 1974 was accompanied by a 3.2% decrease in demand for blast-furnace coke. Output of oven coke plus beehive coke averaged 5.13 million tons per month, with 5.49 million tons produced in January and 4.13 million tons in December. Daily production for the year averaged 168,715 tons, down 4.3% from the average daily output of 1973.

Forty-eight furnace plants produced 91.6% of the oven coke. These plants, owned by or financially affiliated with iron and steel companies, were operated mainly to produce coke for use in iron blast furnaces. The remaining oven coke was produced by 14 merchant plants, a segment of the coke industry producing and selling blast furnace, foundry, and other grades of coke on the open market.

Coke was produced in 19 States in 1974. The relative amounts of coke produced in the various States have changed little in the past decade. Connecticut and Massachusetts have ceased to be producing States, and production was discontinued in New Jersey in 1971. Because coke is used principally for blast furnace fuel, the coke industry is concentrated in the major steel-producing areas of the Eastern and North Central States. The bulk of the 1974 coke output was produced in 14 States east of the Mississippi River. Five States west of the Mississippi River produced less than 7% of the total production. Pennsylvania, the largest producer, accounted for 27% of the output and was followed by Indiana and Ohio. The combined ouput of these three States was 56% of the national total.

An average of 1,366 pounds of breeze-free coke was produced for each ton of coal carbonized in the United States in 1974. The yield of coke from coal, which averaged 68.28%, has remained fairly constant during the past decade.

Table 1.—Salient coke statistics

	1970	1971	1972	1973	1974
United States:					
Production:					
Oven coke thousand short tons	65,654	56,664	59,853	63,496	60,737
Beehive coke do	871	772	654	829	845
Total[1] do	66,525	57,436	60,507	64,325	61,581
Exports do	2,478	1,509	1,232	1,395	1,278
Imports do	153	174	185	1,078	3,540
Producers' stocks, Dec. 31 do	4,113	3,510	2,941	1,184	935
Consumption, apparent do	63,207	56,689	60,046	r 65,802	64,092
Value of coal-chemical materials used or sold thousands	$293,464	$260,171	$294,905	$355,667	$652,735
Value of coke and breeze used or sold thousands	$1,899,116	$1,848,781	$2,080,074	$2,575,074	$4,609,209
Total value of all products used or sold[1] do	$2,192,580	$2,108,953	$2,374,979	$2,930,817	$5,261,944
World production:					
Hard coke thousand short tons	386,308	377,744	r 375,364	r 400,742	408,741
Gas house and low-temperature coke do	28,415	24,183	r 20,031	r 19,430	19,390

r Revised.

[1] Data may not add to totals shown because of independent rounding.

The word breeze refers generally to coke particles, carbonized bony coal, and slaty rock passing through a ½-inch-square screen. Approximately 29% of the breeze produced in 1974 was used as a fuel in agglomerating plants. The remainder was sold mainly for use as a fuel for smelting phosphate rock to produce elemental phosphorus. The amount of breeze sold has increased significantly in recent years; about 45% of the quantity produced was sold in 1974.

The breeze yield per ton of coal carbonized is influenced by oven operating practices and the quality of the coals carbonized. The lowest yield equaling 3.6% was recorded for Pennsylvania; the yield for Indiana averaged 8.0%. The national average yield of 5.7% has not varied significantly during the past decade.

An average of 114.6 pounds of breeze was produced for each ton of coal carbonized at oven-coke plants. Breeze yields of beehive-coke plants were substantially higher than those of oven plants, but beehive breeze production was negligible because only a few plants had recovery facilities.

CONSUMPTION AND SALES

Apparent consumption of coke in the United States totaled 64.1 million tons. This quantity (domestic production plus imports, minus exports and changes in stocks) was 1.7 million tons less than that consumed in 1973. The decrease was attributed to smaller demand for blast-furnace coke, caused by a 5.3-million-ton decrease in blast-furnace pig iron and ferroalloys production.

The amount of coke required to produce 1 short ton of hot-metal ouput increased from 1,200 pounds in 1973 to 1,218 pounds in 1974.

Although a variety of operating practices affect blast-furnace coke rates, the increase in the 1974 coke rate resulted despite a 21.7-pound coke-equivalent increase of supplemental fuels injected through blast furnace tuyeres per ton of hot metal produced. The principal fuels used in blast furnaces to reduce coke consumption in 1974 were fuel oil, tar and pitch, and natural, coke oven, and blast furnace gases. Although the units of measurement differ, and the quantity of each fuel used varied greatly, the total calorific value of all supplemental fuels consumed in blast furnaces in 1974 was equivalent to approximately 5.3 million tons of coke. Oxygen consumption in blast furnaces equaled 25,813 million cubic feet, up 23% from the 1973 consumption. The use of oxygen reduces the blast-furnace coke requirement by making available more sensible heat during the reduction of iron ore to pig iron.

A total of 61.6 million tons of oven and beehive coke was sold and used for all purposes, of which 90% was oven coke supplied by furnace plants. The bulk of this coke was retained by producers for use in their own blast furnaces. Furnace plants sold about 1.9 million tons of coke, 28% of the total coke sold commercially. Fifty-nine percent of the furnace-plant sales was shipped to other blast-furnace plants.

Merchant plants distributed 5.1 million tons of coke, 97% of which was sold on the open market. Principal markets were blast-furnace operations without coke facilities, independent gray-iron foundries, nonferrous smelters, and chemical plants. About 3% of the merchant coke was used by its producers, principally in chemical plants and affiliated foundries.

One percent of the total coke distributed was supplied by beehive plants and was sold for blast-furnace use.

All States except Alaska and Hawaii, received shipments of coke and breeze in 1974. Alabama, Illinois, Indiana, Michigan, New York, Ohio, Pennsylvania, and West Virginia, which are the major iron- and steel-producing States, received 84% of the total coke and breeze distributed.

The bulk of the coke distributed was blast-furnace coke that was consumed within the producing State, as most blast furnaces were integrated with coke ovens. A few companies shipped coke to affiliated blast furnaces in other States.

About 5.5% of the breeze-free coke distributed was shipped to foundries. The chief recipients of foundry coke were the automotive, farm-machinery, machine-tool, heavy-machinery, railroad, and electrical-equipment industries. Most of these industries are concentrated in the East and Midwest. The combined consumption of Alabama, Illinois, Indiana, Michigan, New Jersey, New York, Ohio, Pennsylvania, and Wisconsin accounted for 74% of the foundry-coke shipments. Foundry coke also was consumed in 36 other States.

Coke used for miscellaneous applications was widely distributed, with 44 States receiving shipments of other industrial coke. The principal consumers were nonferrous smelters, alkali plants, and plants that manufacture calcium carbide and elemental phosphorus. Alabama, Idaho, Michigan, Ohio, Pennsylvania, and Utah received 51% of other industrial coke.

STOCKS

Yearend stocks of coke were 21% less than at yearend 1973 as the quantity of coke distributed exceeded production by about 1.1 million tons. Oven-coke plants ended the year with an average 4.7-day supply based on the December rate of production. Normally, beehive plants do not stock coke.

The bulk of the stock was at furnace plants, that had roughly a 6-day supply compared with a 2-day supply at merchant plants. There were no producers' stocks of beehive coke at the end of 1974.

Stocks of coke breeze at producers' plants increased 12% during 1974. Roughly, 72% of the breeze on hand was at furnace plants.

VALUE AND PRICE

The average value of receipts for all grades of oven coke reached $65.74, up $22.82 per ton, and beehive coke averaged $44.02, up $16.71 per ton. The 1974 values represented increases of 53% for oven coke and 61% for beehive coke.

For oven coke, an increase of 44% raised the average price of foundry sales to $78.92 per ton; commercial sales to blast-furnaces increased an average of 64% to $53.28 per ton. Oven coke used for other industrial purposes increased 62% in price to $59.33 per ton.

The differential between the average price of blast-furnace and foundry-oven coke is attributed to the tighter specifications for foundry coke that make it a more costly product and to its superior properties resulting from the long coking times at lower temperatures of coal mixtures containing up to 50 weight-percent low-volatile coal, and occasionally petroleum coke, anthracite, or pitch. The differences in the average values of oven and beehive cokes are partially due to the additional transportation costs of coal delivered to oven-coke plants, and the substantial investment and maintenance costs of slot-type ovens.

FOREIGN TRADE

Foreign trade in coke was relatively active. Exports at 1,277,681 tons amounted to 2.1% of production. Approximately 77% of the coke exported went to Canada, Mexico, and West Germany at an average value of $33.84 per short ton. Total exports averaged $34.09 per ton, up $10.33 per ton from $23.76 in 1973. Imports of coke at 3,540,326 tons far exceeded the 1,077,737 tons imported in 1973. The value of all coke imports in 1974 averaged $54.56 per ton compared with $36.43 per ton in 1973. West Germany and the United Kingdom furnished 88.8% of the imports at an average value of $54.31 per ton.

Canada remained the principal foreign market, receiving nearly 709,717 tons, or 55.6% of the foreign shipments. Other countries receiving substantial amounts of U.S. coke were West Germany, Mexico, the Netherlands, and Spain. Although coke was shipped to 23 countries in 1974, these four countries together with Canada received 92% of the total exports. Eighty-one percent of the total coke exported through 24 customs districts was shipped from the Baltimore, Buffalo, Detroit, Laredo, Norfolk, and Philadelphia customs districts.

Because of shortages of domestic coke, imports increased 228% above those of 1973. This was the largest quantity of coke imported in a single year to date.

COKING COALS

QUANTITY AND VALUE OF COAL CARBONIZED

A total of 89.8 million tons of bituminous coal was carbonized at high temperatures for the production of coke. This quantity, equaling 15% of the 1974 bituminous coal output of the United States, was the second-largest coal market. In addition to bituminous coal, 444,000 tons or approximately 7% of the U.S. anthracite production was used in coking-coal blends. Anthracite was used principally in the production of foundry coke to achieve greater size and density that are desirable properties in the melting of iron in foundry cupolas.

The delivered average value of all coal carbonized by oven-coke plants was $36.49 per ton. The average value of coal carbonized by beehive-coke plants cannot be published to protect confidentiality of the data. Varying percentages of the average value of coal shipped to oven-coke plants represent transportation costs that often exceed the value of the coal at the mine; this factor partially accounts for the high value of the coal consumed in some States.

The average value per ton of coals consumed for coke production at oven-coke plants was 99% greater than in 1973. Coals delivered to some States had increases in average value per ton ranging up to 108%. The highest coal price was recorded for Michigan where the delivered value of coals used for coke production by all plants averaged $44.29 per ton.

An overall average of 1.46 tons of coal, valued at $53.28, was required for each ton of oven coke produced. Beehive ovens required an average of 1.59 tons of coal per ton of coke output.

BLENDING

Blending of coals currently is standard practice at oven-coke plants because many individual coals when used alone do not produce satisfactory quality coke. Blending is performed to improve the chemical and physical properties of coke, to limit the expansion pressure developed on oven walls during carbonization, and to broaden the use of lower quality coals that could not be used alone for metallurgical-grade coke production. Standard oven coke for blast furnace use is made from mixes containing up to 25 or more weight-percent of low-volatile coals blended with medium- and high-volatile coals. High-volatile coals when used alone produce lower yields of weaker coke. Low-volatile coals when used with high-volatile coals improve the yield and the physical properties of the coke. The weight-percentages of low-volatile coals used are restricted because of their cost and their expansive behavior that damages oven walls. Some plants add medium-volatile coals or other materials to their blends of high- and low-volatile coals to replace the equivalent weight of a blend of low- and high-volatile coals; the use of anthracite imparts size and density to the coke; and the presence of tar pitch in the coal mix increases the strength of coke. Blending also permits the use of some high-sulfur-content coals with low-sulfur coals to produce a coal mix for producing high-quality coke with an acceptable sulfur content.

The overall percentages of high-, medium-, and low-volatile coals used in coke mixes have varied little in the past decade although there are wide variations in the proportions used by individual plants. West Virginia plants and those in the Western States used the largest percentages of high-volatile coals in their blends, but plants in Minnesota and Wisconsin used relatively high percentages of low-volatile coal. Compared with furnace plants, some merchant plants used approximately 50 weight-percent of low-volatile coal to produce strong foundry coke.

The types of coal used in each plant are determined by the availability of the desired coal; the quality of various coals including moisture and content and composition of ash, ash-fusion temperature, volatile content, expansive properties; cost of delivered coal; storage characteristics; and the physical and chemical properties of the final coke.

SOURCES OF COAL

Of the 25 States that produced bituminous coal in 1974, only 14 produced coal that was shipped to coke plants. Ten States supplied 87.7 million tons of coal for coking. The combined shipments from Arkansas, Maryland, Ohio, Tennessee totaled only 398,000 tons.

Thirty percent of the coals received by oven-coke plants was produced in West Virginia and 28% in Pennsylvania. West Virginia shipments comprised low-volatile coals from McDowell, Wyoming, and Raleigh Counties, and medium-volatile coals from Fayette, Logan, Mingo, and Nicholas Counties. Pennsylvania supplied high-volatile coals from Allegheny, Greene, and Washington Counties and low-volatile coals from Cambria and Somerset Counties. Pennsylvania and West Virginia coals were widely distributed and used in most of the coke-producing States.

Kentucky supplied 17% of the coal shipments to coke plants, all of which was high-volatile coal produced mainly in Floyd, Harlan, Letcher, and Pike Counties.

Illinois produced high-volatile coking coals mainly in Franklin and Jefferson Counties; other States with substantial production were Alabama, Colorado, Utah, and Virginia. Most of the coal produced in these States was used within the State. Colorado and Utah, however, supplied most of the coals that were carbonized in California.

CAPTIVE COAL

Approximately 52% of the coal received by oven-coke plants was produced by company-owned or affiliated mines. This captive coal, ordinarily, does not move in commercial channels. In 1974, 54% of the coal received by furnace plants was captive. Some merchant plants also owned coal mines, but only 22% of the coal received was captive production.

STOCKS

Stocks of bituminous coal at oven-coke plants remained fairly constant throughout the year, ranging from an average supply of 25 to 32 days at each plant. Bituminous stocks reached their highest yearly level during May when month-end quantities totaled 7.8 million tons. The lowest level, 6.0 million tons, was reported at the end of December.

Despite market competition for low-sulfur coals during the latter part of 1974, bituminous coal stocks at the end of 1974 were only 12% lower than when the year began. The 6.0 million tons on hand at all plants at yearend was equivalent to a 31-day supply at the December 1974 rate of consumption.

Stocks of anthracite at the end of 1974 totaled 172,000 tons, which was equal to a 141-day supply at the 1974 average rate of consumption.

COAL CHEMICALS

The term "coal chemicals" refers to the refined materials recovered from the crude liquids obtained from the gases and vapors released during coal carbonization. Three materials—ammonia, tar, and light oil—are normally recovered at oven-coke plants using condensation and absorption processes. The remaining noncondensible material, which is rich in hydrogen and methane, is called coke-oven gas. Except for ammonia, which is recovered as an aqueous solution or converted to ammonium sulfate or phosphate and sold as produced, the materials are, in most instances, further processed to yield a number of primary organic chemicals or chemical mixtures, the most important of which are benzene, toluene, xylene, solvent naphtha, crude chemical oil (often termed carbolic oil), and pitch. Although many oven-coke plants in the United States are equipped to process tar and light oil, the extent to which individual plants are utilized depends upon economic conditions and the general size of the plant because yields of the various chemicals are low.

Yields of chemicals vary with the kind of coals carbonized, carbonizing temperatures, and operating techniques and equipment, but approximately 315 pounds of coke-oven gas, 90 pounds of tar, 20 pounds of crude light oil, and 5 pounds of ammonia are recovered for each ton of coal carbonized. In standard units of measure, these quantities amount to about 10,500 cubic feet of coke-oven gas, 10 gallons of tar, and 3 gallons of crude light oil. Ammonia was recovered as ammonium sulfate at most coke plants at a yield averaging 17 pounds per ton of coal.

In terms of calorific value, the products, excluding coke, recovered by oven-coke plants in 1974 totaled 547 trillion Btu. This quantity was roughly equivalent to about 23% of the heating value of the coals carbonized.

Among the technological developments concerning coal chemicals, The Dow Chemical Co. of America reported that phenanthrene was easily separated from anthracene if the mixture was dissolved in ethanol or acetone. Using a process protected by U.S. Patent 3,793,387 (1974), phenanthrene was precipitated by the addition of water to give a 70% recovery.

According to the Great Lakes Carbon Corp., spinnable pitch may be produced by forming the pitch into particles smaller than 100 mesh before dissolving them in two stages, the second stage consisting of dissolving the undissolved material from the first stage. The process is protected by British Patent 1,352,625 (1974).

U.S. Patent 3,787,300 (1974) claims

that the life of molten cryolite cells for aluminum production can be prolonged by coating the anode and cathode with pitch mixtures.

West German Patent 2,300,023 (1973) disclosed a process for producing isotropic carbon from creosote oil and cracked petroleum distillates by treatment with air followed by carbonization at 1,000° C.

Tars resulting from the carbonization of bituminous coal containing added pitch were processed by a procedure giving improved heat balance and economy. A nonionic demulsifier used before distillation improved the gravity separation of water and thus decreased the load on the distillation column.[2]

Eight U.S. steel companies were building new coke batteries at yearend that were expected to increase the supplies of ammonium compounds and aromatics[3] as shown in the following tabulations:

Company	Location	Million tons per year	Start-up target date
Armco Steel Corp	Middletown, Ohio	[1]2.0	July 1976.
Bethlehem Steel Corp	Bethlehem, Pa	[1]1.3	Mid-1975.
Inland Steel Co	East Chicago, Ind	1.8	1978.
Jones & Laughlin Steel Corp	Aliquippa, Pa	1.5	Mid-1975.
	do	1.5	Not contracted.
Lykes-Youngtown Corp	Indiana Harbor, Ind	1.5	Mid-1977.
Republic Steel Corp	Cleveland, Ohio	0.4	1976.
	Warren, Ohio	0.8	1978.
United States Steel Corp	Gary, Ind	[1][2]1.25	Late 1975.
	do	[1][2]1.25	Late 1976.
Wheeling-Pittsburg Steel Corp	Follansbee, W. Va	1.5	Mid-1977.

[1] Estimated by Chemical Week.
[2] Minimum capacity.

Product		Present capacity[1]	Additional capacity by 1981[1]
Ammonia compounds[2]	thousand tons per year	700	125
Benzene	million gallons per year	180	25
Toluene	do	40	5
Xylenes	do	8	1
Phenol	million pounds per year	30	4
Naphthalene[3]	do	640	85
Cresols	do	100	9
Xylenols	do	35	3
Phenanthrene, anthracene, other cyclics	do	800	80

[1] From byproduct coke ovens, including products recovered from coke-oven materials shipped to petroleum refineries and coal-tar distillation plants for further processing.
[2] As ammonium sulfate equivalent.
[3] Including methyl naphthalenes.

Sources: U.S. Bureau of Mines, U.S. International Trade Commission, Koppers Co., "Encyclopedia of Chemical Technology," Chemical Week estimates.

COKE-OVEN AMMONIA

Coal carbonized at high temperatures releases nitrogen and hydrogen, which combine to produce ammonia. Ammonia must be removed from the gas to reduce the subsequent formation of corrosive compounds with hydrogen sulfide and hydrogen cyanide. Coke plant operators normally recover ammonia as an aqueous solution, or as ammonium sulfate or phosphate. However, 14 plants did not recover ammonia as a salable product in 1974.

Production of ammonia decreased 9% because the number of recovery plants decreased by three. However, the average value per ton of both ammonium sulfate and ammonia liquor increased, as did the total value of sales. Ammonia products sold in 1974 represented 5.7% of the total value of all coal-chemicals sales.

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[2] BCRA Review. V. 1, No. 2, April–June 1974, p. 121.

[3] Chemical Week. Steel Industry Buildup Brings Chemical Bonus. V. 116, No. 7, Feb. 12, 1975, pp. 11–12.

COKE-OVEN GAS

Coke-oven gas, having a gross heating value usually ranging from 520 to 600 Btu per standard cubic foot, is principally used for heating coke ovens and steel- and allied plant furnaces. Small quantities are also sold for distribution through city mains and for other industrial uses. Gas yields vary among plants, but the average quantity of gas produced for each ton of coal carbonized in all slot ovens was 10,890 cubic feet, 1.6% more than the average yield of 10,720 cubic feet for 1973. However, total gas production decreased 2.8% because about 4.3% less tonnage of coal was carbonized in 1974.

Approximately 39.4% of the coke-oven gas produced was used for heating coke ovens. The remainder of the gas produced was used by producers to fuel boilers, transferred to steel or allied plants to heat open-hearth and other metallurgical furnaces, sold for industrial use, or distributed through city mains. A small part of the production was wasted when the gas was burned in the atmosphere in situations where production exceeded demand.

Although coke-oven gas was the principal fuel used for heating coke ovens in 1974, some operators used a mixture of coke-oven and blast-furnace gas, or a mixture of blast-furnace and natural gas for underfiring. A total of 416 billion cubic feet of coke-oven gas equivalent was so consumed, of which approximately 92% was coke-oven gas.

Surplus coke-oven gas used and sold in 1974 was valued at $299 million, a 57% increase above the 1973 value. No value was reported by producers for coke-oven gas used to heat coke ovens, but by applying the average value of $0.521 per thousand cubic feet reported for surplus gas to the gas used for underfiring, the total value of all coke-oven gas used and sold in 1974 would be $497 million. This amount is equivalent to 15.4% of the total value of the coal carbonized at oven-coke plants.

COAL TAR AND DERIVATIVES

All oven-coke plants produced tar in quantities varying between 6 and 9 gallons per ton of coal carbonized. Because the carbonization of high-volatile coals yields a larger yield of tar, coke plants in California, Colorado, and Utah using large percentages of high-volatile coals had the highest tar yields. Because 4.3% less coal was carbonized in oven-coke plants and the yield per ton of coal was down 3.4%, tar production was 7.5% less than in 1974. Both merchant and furnace plants had lower yields and also lower production.

Coke-plant operators consumed 54.6% of the crude tar produced. Of this quantity, 50% was processed (refined or topped) and 49% underwent no processing and was burned for fuel. The remaining production together with withdrawals from stock was sold to tar-distilling plants for refining into a variety of tar-derived products.

Most of the coke plants that processed crude tar in 1974 fractionated the tar in a process called "topping," whereby distillate fractions, consisting mainly of low-boiling tar acids and bases together with naphthalene, are obtained from the crude tar. The residue (called soft pitch) was usually used for fuel. Furnace plants integrated with steel plants in particular benefited from this operation because they could sell the distillate and retain the pitch for use as fuel, thereby reducing the amount of other fuels normally purchased. However, the relative quantities of tar topped, burned, or sold, depend on a number of economic factors, such as the availability and current market prices of tar, tar distillates, and other substitute fuels. Most of the merchant plant tar production was sold because these plants had little use for the pitch that represented 65 to 92 volume-percent of the crude tar feed to the topping stills.

The majority of the plants that processed crude tar recovered only crude chemical oil (also known as carbolic oil) and liquid residual tars ranging up to soft pitch. Some of the larger plants recovered a number of tar-based products, including creosote oil, cresylic acid, cresols, naphthalene, phenol, cresols, xylols, pyridine, quinoline, and medium and hard pitch. Although statistics on many of these tar derivatives are not shown in this report because of company confidentiality, the data were transmitted to the U.S. Tariff Commission, for publishing with similar data from tar distillers and petroleum refiners, in monthly and annual reports on synthetic organic chemicals.

CRUDE LIGHT OIL AND DERIVATIVES

Crude light oil is a mixture of aromatic hydrocarbons that are absorbed from the gas after tar, ammonia, and in some instances, naphthalene have been removed. Crude tar also contains an insignificant amount of light oil, but this usually is not recovered at coke plants. Virtually all crude light oil produced at coke plants is recovered by an absorption process in which the gas is contacted with a high-boiling petroleum oil or a coal-tar-based distillate as the gas passes through absorption equipment. Crude light oil is stripped from the absorption oil by direct steam distillation. Approximately 2.5 to 3.0 gallons of crude light oil (20 pounds) is recovered for each ton of coal carbonized. Yields vary with the kind of coals carbonized and with operating conditions. An average of 2.64 gallons of light oil per ton of coal carbonized was recovered at 51 plants that extracted light oil in 1974. Yields per ton of coal were about the same in both merchant and furnace plants as in 1973. Eleven plants left the light oil in the gas to increase its calorific value.

Producers sold 44% of their crude light oil output. The modest increase of crude light oil sales in recent years was attributed to the inability of some plants to produce derivatives meeting the rigid specifications of dependable quality and competitively priced aromatic petrochemicals. Such plants sell crude light oil to petroleum-refining companies for processing with petroleum-derived fractions into benzene, toluene, and a number of other chemical intermediates.

As with other coal-chemical materials, yields of products derived from crude light oil vary, but approximately 82 volume-percent of the crude light oil processed was recovered in 1974 as salable products; 60.2% as benzene, 11.5% as toluene, 2.7% as xylene, and 7.6% as other products. Approximately all of the benzene production was classed as specification grades. In past years, a large amount of motor-grade benzene was used to increase antiknock properties of gasoline, but present petroleum-refining techniques have all but eliminated this use for benzene.

The unit value of light oil derivatives sold in 1974 ranged from $0.763 per gallon for specification-grade benzene to $0.265 per gallon for all grades of solvent naphtha. The average value of all light oil products sold increased 181% to $0.705 per gallon.

WORLD REVIEW

World production of metallurgical coke in 1974 was estimated at 408.7 million short tons. This quantity was 2% higher than the 1973 output and the increase was attributed to large production gains in West Germany, Italy, the U.S.S.R., the United Kingdom, and Japan.

Europe, with 56% of the total, led in world production. European output was 4% greater than in 1973, mainly because of larger output in the U.S.S.R. Asia, with eight producing countries, ranked second in output while North America, with only three producing countries, ranked third.

The U.S.S.R., with nearly 23% of the world output, was the largest producer of coke. The U.S.S.R. production increased 3.7% over that of 1973; the estimated 93.1 million tons of coke and breeze produced in 1974 was a record output for the country. Metallurgical coke production, however, probably totaled about 88 million tons based on an estimated 5.1 million tons of breeze production.

The United States, with 15% of the world total, ranked second in production, and Japan, with 12%, ranked third. The United States had a 4.3% production decrease, but Japan's output was 3% above that of 1973.

Other leading coke-producing countries in order of output were West Germany, the People's Republic of China, Poland, the United Kingdom, and France. Although metallurgical-grade coke was produced in 30 other countries, the production of these five countries combined with that of the U.S.S.R., the United States, and Japan accounted for 79% of world production.

In addition to metallurgical-grade coke, which is produced at high-temperatures in conventional slot- and beehive-coke ovens, 19 million tons of other coke was produced at high, medium, and low temperatures in vertical and horizontal retorts and other types of carbonizing equipment. Commonly referred to as "gashouse" or "soft" coke, this material is not suitable for most metallurgical applications, but is used principally for domestic heating, chemical processing, and gas production. Production of "gashouse" coke has been declining in recent years, and the 1974 world output was only about one-fourth as large as that of a decade ago.

Nippon Steel Corp. (NSC) urged Japanese steelmakers to refrain from buying high-priced coking coal from the United States under spot contract conditions. NSC claimed that acceptance of the higher prices in the United States would stimulate other suppliers such as Canada, Australia, and the U.S.S.R. to raise prices to similar levels. The Japanese steel industry planned to import 16 million tons of U.S. coking coal, about 12 to 13 million tons of which were under long-term contracts that had fixed prices. It was also predicted that acceptance of high-priced coal under spot contracts would ultimately result in increases in the price of long-term contracts.

NSC developed an industrial process for using a substantial proportion of noncoking coal in a coke production venture. Advantages cited were that the consumption of coking coal could be reduced to 55% from 70%, thereby making it possible to decrease consumption of extra-hard coking coal from a previous minimum of 10% to 4% and that a low-operating-cost briquette-making plant would permit use, up to 20% of the total weight of coals used, of noncoking coal previously considered unusable in coke production.

The principal Canadian steel producers —Steel Company of Canada (Stelco), Dominion Foundries and Steel Ltd. (Dofasco), The Algoma Steel Corporation, Ltd. (Algoma), and others—continued to obtain most of their coking coal from the United States, largely from the Appalachian coalfields. Some shipments of western Canadian coking coal were made to eastern steel plants for testing. The new planned transshipping terminal at Thunder Bay, Ontario, could help move Canadian metallurgical coal eastward as well as thermal coal for powerplants.

TECHNOLOGY

The reduction of atmospheric pollution at coke plants continued to receive attention although no combinations of equipment proved to be totally effective and no major advances were forecast. The use of a hood to enclose the coke guide and coke car was described in British Patent 1,329,533 (1973) issued to The Koppers Co. Inc., and titled: "Improvements in or relating to preventing air pollution about coke ovens."

The method adopted at the Warren, Ohio, plant of Republic Steel Corp. to reduce air pollution during on-main charging of oven batteries equipped with a single collecting main was described.[4] A breeches pipe was substituted for one of the center hoppers of the charging car. This design reduced the emission 80%. Remaining problems comprised the difficulty in attaining a full charge of coal, lack of suction through the breeches pipe, an increase in leveling time, and possibly an increase in the pentane-insoluble content of the tar.

The British Carbonization Research Association (BCRA) in October 1974 issued the third edition of a 20-page special publication titled "Practical Suggestions for the Reduction of Smoke, Dust and Grit at Coke Ovens." Although most of the text relates to coke ovens, discussion is also given to the handling and stocking of coal, coke and other bulk materials, boilers and ancillaries, odors from coking plants, and the determination of the mass emission factor.

The smokeless-charging procedures developed for use at the Clairton Works of the United States Steel Corp. was described in an AIME publication.[5] The procedure comprises the sequential discharge of coal from hoppers of the charging car in conjunction with the use of ascension-pipe steam injectors of increased size operated at higher pressure to increase the capacity to aspirate the gases and vapors from the oven chamber. The coal leveler bar is provided with a specially designed muff.

USS Engineers and Consultants Inc. developed a system, described in British Patent 1,334,546, for the smokeless charging of coke ovens. A special charging main is provided in addition to normal double collecting mains and is located above one of the collecting mains. The special main is connected into the central offtake from the oven battery to the byproduct plant, downstream from the butterfly valves controlling the back pressure in the regular collecting mains. During oven charging, the drop sleeves of the charging car are connected by a duct system and flexible couplings to a side arm of the charging main. A vacuum equal to 25 millimeters of H_2O is maintained in the charging main in contrast to the positive pressure maintained in the regular collecting mains. An additional connection between the charging main and the collecting main below it is provided with a valve controlled by a gas analyzer so that the oxygen content in the charging main is kept below the lower explosive limit by the passage of coke oven gas from the regular collecting main.

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[4] Mantz, G. H. Ironmaking Proc. AIME 1973, v. 32, pp. 271–275.

[5] Weber, G. T., and Lewis, R. E. Ironmaking Proc. AIME 1974, v. 33, pp. 276–286.

Construction activities and some initial break in runs of a formed coke pilot plant were continued at Sparrows Point, Md., by a consortium of four steel companies and one coal company. The plant is designed to use either coking-grade or weakly coking-grade coal. Other objectives of the project are to curtail gas and dust emissions at coke works, to stretch the supply of low-volatile coal by using a single high-volatile coal, and to use surplus gas from the process, after cleaning, in steel plants and for power generation.

A series of test runs using 20,000 tons of formed coke mixed with conventional byproduct coke were performed in a blast furnace a Inland Steel Co.'s Indiana Harbor Works, East Chicago, Ind. The furnace operation and iron quality were normal even when 50% of the coke requirement was supplied by formed coke made in the FMC Corp. Kemmerer, Wyo., plant using subbituminous Western coal.

British Patent 1,350,494 was issued in 1974 to Pullman Inc., for a process to produce formed coke for blast furnaces by briquetting dried, rushed, minus 10 mesh-noncaking or weakly caking coal with a residue from the thermal cracking of gas oil, and carbonizing the briquets. The heating rate in the critical temperature range 370° to 600° C is kept within defined limits to avoid the excess liquefaction of the binder that would occur with too low a rate and the fissuring of the briquets that would occur at too high a rate.[6]

Cupola tests using formed coke made by the IChPW process and incorporating desulfurizing additions such as 5% manganese ore or limestone were described.[7] Formed coke was used as a replacement for the charge coke only, and as a replacement for the charge coke and bed coke. The sulfur content of the cast iron was about 25% less than when using conventional oven coke.

The British Cast Iron Research Association found no improvements when the mean size of foundry coke was increased above 3.4 inches. The use of larger coke increased combustion efficiency, but it also increased the sensible heat loss.[8]

Five characteristics of good foundry coke that increased its efficient use in cupolas were discussed.[9] Foundry coke should be uniform in size, stability, strength, and density and have proper chemical composition. Ash, necessary to strength, should not exceed 8.0%.

Collective operational changes including longer coking time, improved coal pulverization, and increased bulk density resulted in improved coke stability, a measure of coke strength. The unit production of both 1,900-tons-per-day and 2,800-tons-per-day capacity blast furnaces increased as the coke stability increased. Production of hot metal increased almost 2% for each percent increase in stability. The effect of coal sizing was pronounced. For example, coal sized at 74% minus ⅛ inch produced a coke having 51.0 stability; coal pulverized to 85% minus 1/8 inch produced coke having 59.5 stability. Hot-metal production using 51.5-stability coke with a maximum attainable wind rate of 92,000 cubic feet per minute was 2,400 net tons per day; coke with 59.0 stability permitted a wind rate of 110,000 cubic feet per minute resulting in a hot-metal production of 2,800 net tons per day. The coke rate in pounds consumed per ton of hot metal produced decreased from 925 pounds to 885 pounds as the coke stability increased from 55.0 to 59.0.[10]

Simon-Carves Ltd., developed a process

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[6] BCRA Review. V. 1, No. 2, April–June 1974, p. 113.

[7] Ciupka, I. Koks—Smola—Gaz. 1973, v. 18(2), pp. 46–51 (in Polish).

[8] BCRA Review. Coke Utilization. V. 1, No. 2, April–June 1974, p. 117.

[9] Foundry. Using Coke Efficiently in Cupolas. V. 101, No. 8, August 1973, pp. 24–26.

[10] Quigley, J. J. and N. Sayles. Improving Blast Furnace Performance. Iron & Steel Maker, v. 2, No. 2, February 1975, pp. 23–28.

in which coke is quenched by immersion in water. The coke is deposited on the surface of the water and is then moved along the surface or in suspension so that the lumps of coke sink while being saturated with water. The coke is moved along the bottom of the water bath from where it is transferred to an overhead belt conveyor where the adhering water evaporates. The volume of the water in the bath is sufficient to prevent the formation of quench vapors resulting in atmospheric pollution. The process is protected by British Patent 1,347,654 issued in 1974.

British Patent 1,349,186 issued to Firma Carl Still in 1974, describes a coke-oven-heating system in which air and lean gas are distributed to a heating flue through a vertical series of slots connected to a riser duct in the partition between the flue and the adjacent flue. The riser ducts are arranged in pairs (one pair for air and one pair for lean gas per flue). The system permits adjustment of the vertical heat distribution by changing the proportions of air or gas supplied to the riser ducts in each pair, which are connected to different regenerator chambers.

The addition of breeze to a coke-oven charge has a systematic influence on the tensile strength of coke when other carbonization factors are closely controlled. In general, the tensile strength progressively, though nonlinearly, decreases with increasing breeze addition. The extent of this effect depends on the particle size of the breeze. By using smaller particle sizes of breeze at low levels of addition, a coke of increased tensile strength can be produced. At higher levels of breeze addition, the strength is again decreased. A maximum coke tensile strength was obtained when the oven charge contained about 7.5 weight-percent of 63-micrometer breeze. Changes in tensile strength were accompanied by changes in porosity and apparent density. Changes in other textural parameters such as dimensions of the pores and pore walls were less clearly evident.[11]

The operating characteristics of high-capacity coke ovens, design concepts and economics were reviewed.[12] Subjects discussed included heating systems, refractories, heat consumption, carbon formation, and the future of high-capacity ovens.

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[11] British Coke Research Association. Studies of the Tensile Strength of Coke: The Influence of the Addition of Breeze to Charges Carbonized in a 7-kg Oven. Coke Res., No. 81, November 1973, 16 pp.

[12] Wagener, D. Characteristics of High-Capacity Ovens. Iron and Steel Eng., V. 51, No. 10, October 1974, pp. 35–41.

Table 2.—Statistical summary of the coke industry in the United States in 1974

	Slot ovens	Beehive ovens	Total
Coke produced:			
At merchant plants ______ thousand short tons	5,106	(1)	(1)
At furnace plants [2] ______ do	55,630	(1)	(1)
Total [3] ______ do	60,737	845	61,581
Breeze produced ______ do	5,094	--	5,094
Coal carbonized:			
Bituminous:			
Thousand short tons	88,410	1,340	89,750
Value (thousands)	3,230,812	W	W
Average per ton	$36.54	W	W
Anthracite:			
Thousand short tons	444	--	444
Value (thousands)	$11,643	--	$11,643
Average per ton	$26.22	--	$26.22
Total coal:			
Thousand short tons	88,854	1,340	90,194
Value (thousands)	$3,242,455	W	W
Average per ton	$36.49	W	W
Average yield in percent of total coal carbonized:			
Coke	68.36	63.06	68.28
Breeze (at plants actually recovering)	5.73	--	5.73
Coke used by producing companies:			
In blast furnaces:			
Thousand short tons	53,567	--	53,567
Value (thousands)	$4,002,398	--	$4,002,398
In foundries:			
Thousand short tons	271	--	271
Value (thousands)	$19,545	--	$19,545
For other industrial uses:			
Thousand short tons	309	--	309
Value (thousands)	$21,872	--	$21,872

See footnotes at end of table.

Table 2.—Statistical summary of the coke industry in the United States in 1974—Continued

	Slot ovens	Beehive ovens	Total
Breeze used by producing companies:			
In steam plants:			
Thousand short tons	204	--	204
Value (thousands)	$2,751	--	$2,751
In agglomerating plants:			
Thousand short tons	1,470	--	1,470
Value (thousands)	$20,248	--	$20,248
For other industrial uses:			
Thousand short tons	971	--	971
Value (thousands)	$14,461	--	$14,461
Coke sold (commercial sales):			
To blast furnaces:			
Thousand short tons	2,820	845	3,665
Value (thousands)	$150,247	$37,196	$187,443
Average per ton	$53.28	$44.02	$51.14
To foundries:			
Thousand short tons	3,110	--	3,110
Value (thousands)	$245,431	--	$245,431
Average per ton	$78.92	--	$78.92
To other industrial plants:			
Thousand short tons	908	--	908
Value (thousands)	$53,878	--	$53,878
Average per ton	$59.33	--	$59.33
For residential heating:			
Thousand short tons	(4)	--	(4)
Value (thousands)	(4)	--	(4)
Average per ton	(4)	--	(4)
Breeze sold (commercial sales):			
Thousand short tons	2,310	--	2,310
Value (thousands)	$41,192	--	$41,192
Average per ton	$17.83	--	$17.83
Coal-Chemical materials produced:			
Crude tar:			
Thousand gallons	677,447	--	677,447
Gallons per ton of coal	7.62	--	7.62
Ammonia:[5]			
Thousand short tons	572	--	572
Pounds per ton of coal	16.65	--	16.65
Crude light oil:			
Thousand gallons	217,416	--	217,416
Gallons per ton of coal	2.64	--	2.64
Gas:			
Millon cubic feet	967,244	--	967,244
Thousand cubic feet per ton of coal	10.89	--	10.89
Percent burned in coking process	39.38	--	39.38
Percent surplus used or sold	59.35	--	59.35
Percent wasted	1.27	--	1.27
Value of coal-chemical materials used or sold:			
Crude tar and derivatives:			
Used thousands	$66,867	--	$66,867
Sold do	$135,792	--	$135,792
Ammonia products[6] do	$37,175	--	$37,175
Crude light oil and derivatives[7] do	$113,799	--	$113,799
Surplus gas do	$299,102	--	$299,102

W Withheld to avoid disclosing individual company confidential data.

[1] Not separately recorded.

[2] Plants associated with iron-blast furnaces.

[3] Data may not add to totals shown because of independent rounding.

[4] Included with "To other industrial plants" to avoid disclosing individual company confidential data.

[5] In terms of sulfate equivalent.

[6] Includes ammonium sulfate, ammonia liquor, and diammonium phosphate.

[7] Includes intermediate light oil.

Table 3.—Summary of oven-coke operations in the United States in 1974, by State

State	Plants in existence Dec. 31	Coal carbonized (thousand short tons)	Yield of coke from coal (percent)	Coke produced (thousand short tons)
Alabama	7	7,314	70.03	5,122
California, Colorado, Utah	3	5,310	62.52	3,320
Illinois	4	3,018	63.46	1,912
Indiana	6	13,743	66.02	9,073
Kentucky, Missouri, Tennessee, Texas	5	2,796	68.67	1,920
Maryland and New York	4	9,312	69.34	6,457
Michigan	3	4,531	71.93	3,259
Minnesota and Wisconsin	3	1,302	73.27	954
Ohio	12	12,968	68.19	8,843
Pennsylvania	12	23,304	70.04	16,323
West Virginia	3	5,262	67.56	3,555
Total in 1974[1]	62	88,854	68.36	60,737
At merchant plants	14	7,071	72.21	5,106
At furnace plants	48	81,783	68.02	55,630
Total in 1973	63	92,806	68.42	63,496

[1] Data may not add to totals shown because of independent rounding.

Table 4.—Summary of beehive-coke operations in the United States in 1974, by State

State	Plants in existence Dec. 31	Coal carbonized (thousand short tons)	Yield of coke from coal (percent)	Coke produced (thousand short tons)
Pennsylvania and Virginia:				
Total 1974	5	1,340	63.06	845
Total 1973	5	1,310	63.28	829

Table 5.—Production of oven and beehive coke in the United States, by month
(Thousand short tons)

Month	1973		1974	
	Total	Daily average[1]	Total	Daily average[1]
OVEN COKE				
January	5,364	173	5,422	175
February	4,891	175	4,974	178
March	5,356	173	5,265	170
April	5,262	175	5,255	175
May	5,454	176	5,369	173
June	5,325	177	5,218	174
July	5,307	171	5,251	169
August	5,383	174	5,219	168
September	5,153	172	5,056	169
October	5,358	173	5,214	168
November	5,218	174	4,427	148
December	5,426	175	4,067	131
Total[2]	63,496	174	60,737	166
BEEHIVE COKE				
January	63	2	67	2
February	62	2	65	2
March	65	2	68	2
April	64	2	70	2
May	66	2	68	2
June	60	2	66	2
July	64	2	61	2
August	71	2	81	3
September	67	2	83	3
October	83	3	87	3
November	81	3	64	2
December	82	3	62	2
Total[2]	829	2	845	2
TOTAL				
January	5,427	175	5,489	177
February	4,953	177	5,038	180
March	5,421	175	5,333	172
April	5,326	178	5,325	178
May	5,520	178	5,438	175
June	5,382	179	5,285	176
July	5,371	173	5,312	171
August	5,454	176	5,300	171
September	5,220	174	5,139	171
October	5,441	176	5,301	171
November	5,299	177	4,491	150
December	5,508	178	4,130	133
Total[2]	64,325	176	61,581	169

[1] Daily average calculated by dividing monthly production by number of days in month.

[2] Data may not add to totals shown because of independent rounding.

Table 6.—Production of oven coke in the United States, by type of plant

(Thousand short tons)

Month	1973		1974	
	Merchant plants	Furnace plants	Merchant plants	Furnace plants
PRODUCTION				
January	460	4,904	446	4,976
February	407	4,484	425	4,549
March	456	4,900	445	4,820
April	434	4,827	438	4,817
May	434	5,019	447	4,922
June	432	4,893	437	4,782
July	438	4,869	428	4,823
August	435	4,948	425	4,793
September	438	4,715	416	4,640
October	448	4,910	429	4,784
November	435	4,783	417	4,010
December	455	4,972	354	3,714
Total[1]	5,271	58,225	5,106	55,630
DAILY AVERAGE				
January	15	158	14	161
February	15	160	15	162
March	15	158	14	155
April	14	161	15	161
May	14	162	14	159
June	14	163	15	159
July	14	157	14	156
August	14	160	14	155
September	15	157	14	154
October	14	158	14	154
November	14	159	14	134
December	14	160	11	120
Average for year	14	160	14	152

[1] Data may not add to totals shown because of independent rounding.

Table 7.—Production of oven coke and number of plants in the United States, by type of plant

Year	Number of active plants[1]		Coke produced (thousand short tons)		Percent of production	
	Merchant plants	Furnace plants	Merchant plants	Furnace plants	Merchant plants	Furnace plants
1970	[2]16	[3]49	5,915	59,739	9.0	91.0
1971	16	[3]49	5,567	51,097	9.8	90.2
1972	14	[3]49	5,626	54,228	9.4	90.6
1973	14	[3]49	5,271	58,225	8.3	91.7
1974	14	48	5,106	55,630	8.4	91.6

[1] Includes plants operating any part of the year.
[2] Includes one light-oil-refining plant.
[3] Includes one tar-refining plant.

Table 8.—Production of coke in the United States, by State

(Thousand short tons)

State	1973	1974
OVEN COKE		
Alabama	5,132	5,122
California, Colorado, Utah	3,386	3,320
Illinois	1,941	1,912
Indiana	9,335	9,073
Kentucky, Missouri, Tennessee, Texas	1,936	1,920
Maryland and New York	7,070	6,457
Michigan	3,871	3,259
Minnesota and Wisconsin	844	954
Ohio	9,438	8,843
Pennsylvania	16,710	16,323
West Virginia	3,332	3,555
Total[1]	63,496	60,737
BEEHIVE COKE		
Pennsylvania	829	845
Virginia	([2])	([2])
Total	829	845
Grand total[1]	64,325	61,581

[1] Data may not add to totals shown because of independent rounding.
[2] Included with Pennsylvania to avoid disclosing individual company confidential data.

Table 9.—Breeze recovered at coke plants in the United States in 1974, by State

(Thousand short tons and thousand dollars)

State	Yield per ton of coal[1] (percent)	Quantity produced	Used by producers: In steam plants: Quantity	Used by producers: In steam plants: Value	Used by producers: In agglomerating plants: Quantity	Used by producers: In agglomerating plants: Value	Used by producers: For other industrial use: Quantity	Used by producers: For other industrial use: Value	Sold: Quantity	Sold: Value	On hand Dec. 31
OVEN COKE											
Alabama	4.54	332	--	--	([2])	([2])	27	502	179	4,438	31
California, Colorado, Utah	4.38	280	--	--	127	1,958	21	271	114	1,767	41
Illinois	6.97	210	([2])	([2])	([2])	([2])	44	610	66	1,001	28
Indiana	8.04	1,105	--	--	428	5,677	118	1,571	516	8,383	228
Kentucky, Missouri, Tennessee, Texas	6.62	185	([2])	([2])	([2])	([2])	76	1,192	69	1,380	44
Maryland and New York	6.87	640	([2])	([2])	([2])	([2])	127	1,653	176	2,694	202
Michigan	6.53	296	--	--	--	--	71	887	184	3,122	82
Minnesota, Wisconsin, West Virginia	6.02	395	([2])	([2])	([2])	([2])	80	1,022	141	2,327	35
Ohio	6.69	868	([2])	([2])	([2])	([2])	180	2,842	659	11,426	53
Pennsylvania	3.58	834	([2])	([2])	819	5,451	234	3,910	207	4,654	135
Undistributed	--	--	204	2,751	601	7,167	--	--	--	--	--
Total 1974[3]	5.78	5,094	204	2,751	1,470	20,248	971	14,461	2,310	41,192	879
Merchant plants	7.61	538	111	1,842	--	--	158	1,770	212	5,443	240
Furnace plants	5.57	4,555	93	909	1,470	20,248	814	12,690	2,097	35,749	639
Total 1973	5.28	4,902	234	1,948	1,689	19,842	917	8,581	2,165	22,505	[4]740
BEEHIVE COKE											
Pennsylvania and Virginia:											
Total 1974	--	--	--	--	--	--	--	--	--	--	--
Total 1973	W	W	--	--	--	--	--	--	--	--	--

W Withheld to avoid disclosing individual company confidential data.

[1] Calculated by dividing production by coal carbonized at plants actually recovering breeze.

[2] Included with "Undistributed" to avoid disclosing individual company confidential data.

[3] Data may not add to totals shown because of independent rounding.

[4] Revised to reflect inventory adjustments.

Table 10.—Oven- and beehive-coke breeze used and sold in the United States, by use

(Thousand short tons)

Year	Used by producers: In steam plants	Used by producers: In agglomerating plants	Used by producers: For other industrial use	Sold	Average value per ton
1970	366	1,948	704	[1]2,067	$9.74
1971	309	1,582	650	1,879	10.80
1972	265	1,305	704	[1]2,118	10.59
1973	234	1,689	917	[1]2,165	10.39
1974	204	1,470	971	2,310	17.83

[1] Does not include beehive-coke breeze sold (to avoid disclosing individual company confidential data).

Table 11.—Apparent consumption of coke in the United States

(Thousand short tons)

Year	Total production	Imports	Exports	Net change in stocks	Apparent consumption [1]	Consumption: In iron furnaces [2]: Quantity	Consumption: In iron furnaces [2]: Percent	Consumption: All other purposes: Quantity	Consumption: All other purposes: Percent
1970	66,525	158	2,478	+998	63,207	58,151	92.0	5,056	8.0
1971	57,436	174	1,509	−588	56,689	51,498	90.8	5,191	9.2
1972	60,507	185	1,232	−586	60,046	54,607	90.9	5,439	9.1
1973	64,325	1,078	1,395	−1,757	r 65,802	60,720	92.3	5,082	7.7
1974	61,581	3,540	1,278	−249	64,092	58,441	91.2	5,651	8.8

r Revised.

[1] Production plus imports, minus exports, plus or minus net change in stocks.

[2] American Iron and Steel Institute; figures include coke consumed in manufacturing ferroalloys.

Table 12.—Coke and coking coal consumed per short ton of pig iron and ferroalloys produced in the United States

Year	Coke per short ton of pig iron and ferroalloys [1] (pounds)	Yield coke from coal (percent)	Coking coal per short ton of pig iron and ferroalloys (pounds, calculated)
1970	1,266.6	69.0	1,833.0
1971	1,260.8	69.0	1,827.2
1972	1,221.6	69.0	1,767.9
1973	1,200.0	68.4	1,754.4
1974	1,218.7	68.3	1,776.5

[1] American Iron and Steel Institute; consumption for pig iron only, excluding furnace making ferroalloys, was 1,260 in 1970; 1,254 in 1971; 1,216.2 in 1972; 1,193.8 in 1973; and not available in 1974.

Table 13.—Oven coke produced in the United States, used by producers, and sold in 1974, by State

(Thousand short tons and thousand dollars)

State	Quantity produced	Used by producing companies: In blast furnaces: Quantity	Used by producing companies: In blast furnaces: Value	Used by producing companies: For other purposes[1]: Quantity	Used by producing companies: For other purposes[1]: Value	Commercial sales: To blast-furnace plants: Quantity	Commercial sales: To blast-furnace plants: Value
Alabama	5,122	3,135	243,671	191	13,583	934	57,576
California, Colorado, Utah	3,320	3,193	196,836	(2)	(2)	--	--
Illinois	1,912	1,807	116,740	(2)	(2)	(2)	(2)
Indiana	9,073	8,414	604,490	4	348	(2)	(2)
Kentucky, Missouri, Tennessee, Texas	1,920	(2)	(2)	34	2,195	(2)	(2)
Maryland and New York	6,457	6,144	460,358	100	7,229	(2)	(2)
Michigan	3,259	(2)	(2)	(2)	(2)	130	9,484
Minnesota, West Virginia, Wisconsin	4,509	4,024	290,699	(2)	(2)	(2)	(2)
Ohio	8,843	7,952	600,639	(2)	(2)	(2)	(2)
Pennsylvania	16,323	15,427	1,250,355	23	1,326	74	4,346
Undistributed	--	3,474	238,605	228	16,735	1,681	78,841
Total 1974[3]	60,737	53,567	4,002,393	581	41,417	2,820	150,247
At merchant plants	5,106	--	--	210	13,722	1,698	77,541
At furnace plants	55,630	53,567	4,002,393	371	27,695	1,123	72,706
Total 1973	63,496	57,360	2,146,153	610	27,717	3,036	98,398

State	Commercial sales—Continued: To foundries: Quantity	Commercial sales—Continued: To foundries: Value	Commercial sales—Continued: To other industrial plants[4]: Quantity	Commercial sales—Continued: To other industrial plants[4]: Value	Commercial sales—Continued: Total: Quantity	Commercial sales—Continued: Total: Value
Alabama	729	55,217	(2)	(2)	(2)	(2)
California, Colorado, Utah	(2)	(2)	(2)	(2)	(2)	(2)
Illinois	--	--	--	--	(2)	(2)
Indiana	(2)	(2)	(2)	(2)	610	47,118
Kentucky, Missouri, Tennessee, Texas	(2)	(2)	(2)	(2)	1,313	62,313
Maryland and New York	(2)	(2)	73	4,428	(2)	(2)
Michigan	(2)	(2)	(2)	(2)	(2)	(2)
Minnesota, West Virginia, Wisconsin	408	33,579	81	5,524	(2)	(2)
Ohio	(2)	(2)	66	3,200	(2)	(2)
Pennsylvania	501	39,106	313	20,176	888	63,628
Undistributed	1,478	117,529	375	20,544	4,027	276,492
Total 1974[3]	3,110	245,431	908	53,873	6,838	449,551
At merchant plants	2,705	215,343	540	28,829	4,943	327,713
At furnace plants	405	30,089	367	25,043	1,895	127,838
Total 1973	3,349	183,337	1,204	44,010	7,589	325,745

[1] Comprises 271,000 tons valued at $19,545,000 used in foundries; 309,000 tons valued at $21,872,000 for other purposes.
[2] Included with "Undistributed" to avoid disclosing individual company confidential data.
[3] Data may not add to totals shown because of independent rounding.
[4] Includes coke used "For residential heating."

Table 14.—Production and sales of beehive coke in the United States, in 1974

(Thousand short tons and thousand dollars)

State	Produced: Quantity	Commercial sales: To blast-furnace plants: Quantity	Commercial sales: To blast-furnace plants: Value	Commercial sales: To foundries: Quantity	Commercial sales: To foundries: Value
Pennsylvania and Virginia:					
1974	845	845	37,196	--	--
1973	829	829	22,665	--	--

State	Commercial sales—Continued: To other industrial plants: Quantity	Commercial sales—Continued: To other industrial plants: Value	Commercial sales—Continued: For residential heating: Quantity	Commercial sales—Continued: For residential heating: Value	Commercial sales—Continued: Total: Quantity	Commercial sales—Continued: Total: Value
Pennsylvania and Virginia:						
1974	--	--	--	--	845	37,196
1973	(1)	(1)	--	--	829	22,665

[1] Included with beehive-coke sold "to blast-furnace plants" to avoid disclosing individual company confidential data.

Table 15.—Distribution of oven and beehive coke and breeze in 1974[1]

(Thousand short tons)

Consuming State	Coke				Breeze
	To blast-furnace plants	To foundries	To other industrial plants[2]	Total[3]	
Alabama	3,028	360	74	3,463	291
Arizona	--	2	2	4	--
Arkansas	--	2	2	4	--
California	1,289	40	23	1,352	52
Colorado	743	8	16	767	48
Connecticut	--	12	(4)	12	(4)
Delaware	--	--	(4)	(4)	(4)
Florida	--	2	8	11	22
Georgia	--	8	5	14	1
Idaho	--	(4)	45	45	--
Illinois	2,867	213	32	3,112	365
Indiana	8,699	175	41	8,915	921
Iowa	--	106	1	107	--
Kansas	--	12	1	12	(4)
Kentucky	1,012	44	17	1,073	119
Louisiana	--	1	26	28	1
Maine	--	1	(4)	1	--
Maryland	3,125	11	2	3,138	258
Massachusetts	--	35	(4)	35	--
Michigan	4,248	659	75	4,982	259
Minnesota	12	23	23	57	58
Mississippi	--	1	1	2	--
Missouri	--	14	56	70	36
Montana	--	2	20	22	20
Nebraska	--	3	6	8	(4)
Nevada	--	(4)	--	(4)	--
New Hampshire	--	1	--	1	--
New Jersey	--	75	57	132	40
New Mexico	--	--	1	1	1
New York	3,104	132	70	3,307	383
North Carolina	--	13	4	17	10
North Dakota	--	1	2	3	(4)
Ohio	9,800	454	125	10,379	734
Oklahoma	--	4	1	5	5
Oregon	--	2	13	14	4
Pennsylvania	14,201	316	194	14,711	624
Rhode Island	--	4	(4)	4	--
South Carolina	--	7	45	52	10
South Dakota	--	(4)	--	(4)	--
Tennessee	32	84	27	143	92
Texas	746	115	52	913	70
Utah	1,184	17	79	1,280	86
Vermont	--	1	--	1	--
Virginia	--	85	3	88	116
Washington	--	4	3	7	3
West Virginia	3,133	6	12	3,151	214
Wisconsin	--	179	3	182	21
Wyoming	--	--	4	4	(4)
Total[3]	57,223	3,232	1,171	61,627	4,861
Exported	9	149	46	204	93
Grand total	57,232	3,382	1,217	61,831	4,954

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[1] Based on reports from producers showing destination and principle end use of coke used and sold. Does not include imported coke which totaled 3,540,000 tons in 1974.

[2] Includes coke used for residential heating.

[3] Data may not add to totals shown because of independent rounding.

[4] Less than ½ unit.

Table 16.—Producers' stocks of coke and breeze in the United States on Dec. 31, 1974, by State

(Thousand short tons)

State	Oven coke				Breeze
	Blast furnace	Foundry	Residential heating and other	Total [1]	
Alabama	49	2	(2)	52	31
California, Colorado, Utah	89	--	--	89	41
Illinois	137	--	--	137	28
Indiana	187	2	(2)	189	228
Kentucky, Missouri, Tennessee, Texas	2	1	(2)	3	44
Maryland and New York	53	--	--	53	202
Michigan	36	(2)	(2)	37	82
Minnesota and Wisconsin	2	(2)	1	3	34
Ohio	103	(2)	1	104	53
Pennsylvania	190	21	9	220	135
West Virginia	48	--	--	48	2
Total 1974 [1]	897	27	12	935	879
At merchant plants	8	10	7	25	240
At furnace plants	889	16	4	910	639
Total 1973	1,093	50	41	1,184	[3]740

[1] Data may not add to totals shown because of independent rounding.
[2] Less than ½ unit.
[3] Revised to reflect inventory adjustments.

Table 17.—Producers' month-end stocks of oven coke in the United States

(Thousand short tons)

Month	At merchant plants		At furnace plants		Total [1]	
	1973	1974	1973	1974	1973	1974
January	326	72	2,497	1,053	2,824	1,125
February	291	69	2,269	1,070	2,560	1,139
March	252	63	2,039	1,100	2,291	1,163
April	206	53	1,829	1,130	2,035	1,183
May	159	46	1,638	1,193	1,796	1,238
June	139	37	1,572	1,205	1,712	1,243
July	148	30	1,367	1,116	1,514	1,146
August	150	31	1,370	1,167	1,520	1,197
September	126	28	1,375	1,293	1,501	1,321
October	96	29	1,339	1,269	1,435	1,298
November	76	31	1,236	1,033	1,313	1,064
December	71	25	1,113	910	1,184	935

[1] Data may not add to totals shown because of independent rounding.

Table 18.—Average receipts per short ton of coke sold (commercial sales) in the United States, by use

Year	To blast-furnace plants	To foundries	To other industrial plants	For residential heating	Total
OVEN COKE					
1970	$25.05	$40.83	$22.74	$20.19	$29.97
1971	30.49	47.98	29.75	21.46	37.41
1972	30.64	51.16	36.43	(1)	40.70
1973	32.41	54.73	36.55	(1)	42.92
1974	53.28	78.92	59.33	(1)	65.74
BEEHIVE COKE					
1970	19.77	18.98	23.01	--	19.39
1971	21.24	--	W	--	21.24
1972	22.01	--	W	--	22.01
1973	27.31	--	W	--	27.31
1974	44.02	--	--	--	44.02

W Withheld to avoid disclosing individual company confidential data.
[1] Included with "To other industrial plants."

Table 19.—Coke exported from the United States, by country and customs district

	1972		1973		1974	
	Quantity (short tons)	Value (thousands)	Quantity (short tons)	Value (thousands)	Quantity (short tons)	Value (thousands)
COUNTRY						
Algeria	--	--	191	$14	--	--
Australia	114	$10	205	4	101	$26
Belgium-Luxembourg	34,041	608	84,714	1,723	52,723	1,507
Brazil	11,775	699	8,465	587	7,059	846
Canada	488,006	14,996	747,543	18,210	709,717	24,760
Dominican Republic	448	11	373	9	791	23
France	262	6	--	--	127	64
Germany, West	141,021	1,989	265,084	5,270	119,331	2,533
India	614	26	1,123	55	--	--
Iran	68	4	184	15	2,879	91
Italy	7,552	106	--	--	6,405	184
Japan	88,236	1,412	32,338	611	4,539	304
Mexico	105,181	4,049	102,284	3,874	157,956	6,107
Netherlands	129,654	1,172	104,845	1,728	95,935	2,389
Norway	8,471	215	8,019	140	12,628	389
Panama	--	--	755	21	187	20
Peru	1,383	86	141	15	128	5
Romania	57,950	1,318	--	--	--	--
Singapore	805	25	52	2	1,760	155
South Africa, Republic of	160	3	759	16	586	156
Spain	106,839	1,683	23,821	405	92,864	3,487
Sweden	169	4	5,480	135	4,592	111
United Kingdom	3,704	229	838	75	732	110
Venezuela	32,174	1,664	543	22	1,812	64
Yugoslavia	12,270	383	6,527	287	3,466	132
Other	636	27	696	20	1,413	101
Total	1,231,633	30,720	1,394,980	33,138	1,277,681	43,564
CUSTOMS DISTRICT						
Baltimore	127,156	2,572	107,709	2,609	30,777	801
Buffalo	230,965	8,796	424,922	11,236	366,858	13,223
Charleston, S.C	--	--	--	--	551	59
Chicago	64,037	753	10,052	111	71,902	2,033
Cleveland	133,412	1,051	78,190	685	12,040	146
Detroit	189,723	4,683	188,367	4,510	304,224	9,770
Duluth	14,163	185	65,022	778	11,851	255
El Paso	158	8	188	3	637	25
Great Falls	170	9	701	13	3,751	165
Houston	2,047	93	1,420	101	5,645	390
Laredo	96,899	3,852	100,856	3,829	154,657	5,982
Los Angeles	53,054	588	20,349	226	66,997	1,218
Miami	367	7	--	--	822	28
Mobile	146,551	3,235	42,056	938	1,086	48
New Orleans	5,050	297	41,459	1,067	17,119	1,075
New York City	580	20	378	10	5,046	121
Nogales	514	24	821	26	551	23
Norfolk	53,650	887	122,222	1,954	114,803	3,057
Ogdensburg	3,812	77	2,282	59	4,997	116
Pembina	16,563	875	17,332	933	24,988	1,065
Philadelphia	81,667	2,357	164,885	3,794	68,382	3,452
San Diego	948	31	522	17	2,111	77
San Francisco	6,744	136	--	--	--	--
Seattle	3,882	183	5,208	292	8,249	432
Other	21	1	39	2	137	3
Total	1,231,633	30,720	1,394,980	33,138	1,277,681	43,564

Table 20.—U.S. imports for consumption of coke, by country and customs district

	1972		1973		1974	
	Quantity (short tons)	Value (thousands)	Quantity (short tons)	Value (thousands)	Quantity (short tons)	Value (thousands)
COUNTRY						
Australia	--	--	123	$2	--	--
Belgium-Luxembourg	--	--	--	--	661	$57
Canada	171,297	$4,276	289,618	9,099	194,731	7,982
Czechoslovakia	--	--	11,574	355	--	--
France	--	--	--	--	2,222	127
Germany, West	268	42	732,084	27,969	2,761,585	156,005
Hungary	--	--	3,190	108	--	--
Italy	--	--	31,945	1,271	7,958	572
Japan	--	--	--	--	4	(1)
Netherlands	--	--	--	--	62,917	5,885
New Zealand	--	--	--	--	8,342	618
Norway	--	--	--	--	55,516	3,860
South Africa, Republic of	13,457	331	--	--	34,222	937
U.S.S.R	--	--	--	--	28,733	2,379
United Kingdom	1	(1)	9,208	459	383,440	14,800
Total	185,023	4,649	1,077,737	39,263	3,540,326	193,165
CUSTOMS DISTRICT						
Baltimore	--	--	225,368	9,749	739,484	35,208
Boston	1	(1)	--	--	--	--
Buffalo	3,110	66	45,746	1,548	13,098	696
Charleston	13,457	331	--	--	11,759	328
Chicago	20,276	730	76,045	2,795	357,555	22,299
Cleveland	25,768	298	--	--	84,142	5,694
Detroit	21,437	342	134,937	4,592	329,724	25,800
Duluth	--	--	--	--	11,570	921
Great Falls	100,187	2,814	102,754	2,885	119,199	4,083
Honolulu	165	11	165	13	--	--
Milwaukee	--	--	--	--	6,180	808
Minneapolis	--	--	--	--	42	1
New Orleans	103	31	94,932	3,576	283,248	17,481
New York City	--	--	--	--	4	(1)
Ogdensburg	229	13	2,352	128	--	--
Pembina	--	--	--	--	2,040	101
Philadelphia	--	--	384,966	13,454	1,570,657	78,834
Portland, Maine	34	1	--	--	30	1
St. Albans	256	12	10,472	528	805	54
Tampa	--	--	--	--	8,342	618
Wilmington, N.C	--	--	--	--	2,497	253
Total	185,023	4,649	1,077,737	39,263	3,540,326	193,165

[1] Less than ½ unit.

Table 21.—Coke: World production by type and country

(Thousand short tons)

Kind of coke and country[1]	1972	1973	1974 ^{p}
METALLURGICAL COKE[2]			
North America:			
Canada[3,4]	5,207	5,920	6,008
Mexico	^{r} 1,935	2,132	^{e}2,282
United States	60,507	64,325	61,581
South America:			
Argentina[5]	^{r} 520	^{r} 490	650
Brazil	^{r} 1,961	1,973	^{e} 2,000
Chile	^{r} 339	331	334
Colombia	578	^{e} 520	441
Peru	37	^{e} 39	^{e} 39
Europe:			
Austria[3]	1,836	1,894	1,911
Belgium	7,980	8,599	8,874
Czechoslovakia	^{r} 11,772	11,989	12,011
Finland[4]	95	67	--
France[3]	^{r} 12,726	13,095	13,539
Germany, East	1,769	2,046	^{e} 2,046
Germany, West	^{r} 37,976	37,475	38,515
Greece	^{r} 297	441	410
Hungary	856	665	704
Italy	^{r} 7,790	8,450	9,442
Netherlands[3]	2,198	2,927	2,959
Norway	^{r} 338	353	353
Poland[6]	^{r} 17,500	18,184	18,663
Romania	1,250	1,456	^{e} 1,700
Spain[7]	^{r} 4,904	4,932	4,776
Sweden[3,4]	^{r} 591	588	530
U.S.S.R.[3]	^{r} 87,935	89,729	^{e} 93,100
United Kingdom	^{r} 14,784	16,308	17,388
Yugoslavia	^{r} 1,351	1,377	^{e}1,450

See footnotes at end of table.

Table 21.—Coke: World production by type and country—Continued

(Thousand short tons)

Kind of coke and country [1]	1972	1973	1974 p
METALLURGICAL COKE [2]—Continued			
Africa:			
Egypt	390	e 400	e 400
Rhodesia, Southern e	270	270	270
South Africa, Republic of	r 3,972	3,961	e 4,200
Asia:			
China, People's Republic of e	26,500	r 30,900	30,900
India [8]	r 9,977	9,809	e 10,100
Iran e [9]	r 440	r 440	550
Japan	r 39,844	48,850	50,301
Korea, North e	2,400	2,400	2,400
Korea, Republic of	--	356	661
Taiwan	r 273	240	206
Turkey e	r 1,430	r 1,410	1,410
Oceania:			
Australia	r 4,831	5,451	5,687
New Zealand	r 5	--	--
Total metallurgical coke	r 375,364	400,742	408,741
GASHOUSE COKE [10]			
South America:			
Brazil	49	40	e 41
Uruguay	15	15	15
Europe:			
Denmark	165	91	e 91
Germany, West	r 1,895	1,705	1,702
Greece	14	11	e 11
Hungary	400	548	e 487
Italy	r 48	([11])	--
Poland	1,513	1,361	1,289
Spain	r 2	--	--
Sweden [12]	r 132	--	--
Switzerland	100	110	33
United Kingdom	r 247	213	e 200
Africa:			
Egypt e	33	33	33
South Africa, Republic of	111	109	e 110
Asia:			
India	87	61	e 40
Japan	r 4,539	4,825	4,838
Sri Lanka	8	--	--
Taiwan	1	([11])	([11])
Turkey e	r 30	r 35	40
Oceania:			
Australia	r 97	([11])	([11])
New Zealand	r 25	26	34
Total gashouse coke	r 9,511	9,183	8,964
ALL OTHER TYPES [13]			
Europe:			
Czechoslovakia	475	--	--
Germany, East [14]	r 6,325	6,326	e 6,326
Asia: India	r 3,720	3,921	e 4,100
Total all other types	r 10,520	10,247	10,426
Grand total	r 395,395	420,172	428,131

e Estimate. p Preliminary. r Revised.

[1] In addition to the countries listed, Algeria, Australia, Malaysia, the People's Republic of China, Mexico, Norway, Romania, and the U.S.S.R. have produced gashouse coke in previous years and may have continued production during the time period covered by this table. However, no official statistics are available, and information is inadequate to make reliable estimates of production levels. Except where otherwise noted, coke breeze has been excluded from this table.

[2] Coke produced at high temperature in conventional carbonizing equipment (including slot and beehive coke ovens).

[3] Includes breeze.

[4] Includes relatively small amounts of gas coke.

[5] Includes 21,728 short tons of breeze coke and 18,613 short tons of imperial coke.

[6] May include some gas coke.

[7] Includes relatively small amounts of low-temperature coke.

[8] Data are total of so-called hard coke production from collieries and coke plants (including those at steelworks).

[9] Data are for years beginning March 21 of that stated.

[10] Includes coke produced at high temperatures in carbonizing equipment designed primarily for gas manufacture (horizontal and vertical coal-gas retorts). In addition to the countries listed, Canada and Finland produce gas coke. However, this figure is not reported separately and has been included with metallurgical coke.

[11] Less than ½ unit.

[12] Excludes small quantities of gashouse coke, which are included with metallurgical coke.

[13] Includes coke produced at low and medium temperatures, as well as that produced in unconventional equipment (chain-grate cokers). In addition to the countries listed, the U.S.S.R. may produce coke from brown coal, but output is not officially reported and no basis is available for reliably estimating output levels.

[14] Includes coke produced from lignite at high temperature.

Table 22.—Quantity, sulfur content, and value at ovens of coal carbonized in the United States in 1974, by State

State	Coal carbonized				Coal per ton of coke	
	Thousand short tons	Average sulfur content (percent)	Value		Short tons	Value
			Total (thousands)	Average		
OVEN COKE						
Alabama	7,314	1.0	$248,264	$33.94	1.43	$48.53
California, Colorado Utah	5,310	.7	183,989	34.65	1.60	55.44
Illinois	3,013	1.0	98,910	32.83	1.58	51.87
Indiana	13,743	.7	508,953	37.03	1.51	55.92
Kentucky, Missouri, Tennessee, Texas	2,796	1.0	91,796	32.83	1.46	47.93
Maryland and New York	9,312	.8	397,632	42.70	1.44	61.49
Michigan	4,531	.9	200,663	44.29	1.39	61.35
Minnesota and Wisconsin	1,302	1.0	50,359	38.68	1.36	52.60
Ohio	12,968	1.0	452,492	34.89	1.47	51.29
Pennsylvania	23,304	1.0	849,150	36.44	1.43	52.11
West Virginia	5,262	1.1	160,246	30.45	1.48	45.07
Total 1974[1]	88,854	.9	3,242,455	36.49	1.46	53.28
At merchant plants	7,071	.9	238,966	33.79	1.38	46.63
At furnace plants	81,783	.9	3,003,488	36.73	1.47	54.52
Total 1973	92,806	--	1,700,119	18.32	1.46	26.75
BEEHIVE COKE						
1974	1,340	--	W	W	1.59	W
1973	1,310	--	16,270	12.42	1.58	19.62

W Withheld to avoid disclosing individual confidential data.

[1] Data may not add to totals shown because of independent rounding.

Table 23.—Bituminous coal carbonized in coke ovens in the United States, by month

(Thousand short tons)

Month	1973			1974		
	Slot	Beehive	Total	Slot	Beehive	Total[1]
January	7,718	102	7,820	7,870	107	7,977
February	7,118	99	7,217	7,205	102	7,307
March	7,847	103	7,950	7,553	107	7,660
April	7,625	102	7,727	7,659	111	7,770
May	7,942	106	8,048	7,796	108	7,904
June	7,678	94	7,772	7,576	106	7,682
July	7,854	101	7,955	7,671	99	7,770
August	7,781	113	7,894	7,588	128	7,716
September	7,497	105	7,602	7,402	132	7,534
October	7,755	132	7,887	7,572	139	7,711
November	7,612	124	7,736	6,482	99	6,581
December	7,909	127	8,036	6,036	99	6,135
Total[1]	92,338	1,310	93,648	88,410	1,340	89,750

[1] Data may not add to totals shown because of independent rounding.

Table 24.—Anthracite carbonized at oven-coke plants in the United States, by month

(Thousand short tons)

Month	1973	1974
January	45	41
February	38	36
March	42	39
April	36	37
May	37	37
June	41	34
July	36	34
August	38	41
September	36	34
October	34	36
November	43	35
December	43	40
Total	[1] 467	444

[1] Data do not add to total shown because of independent rounding.

Table 25.—Average value per short ton of coal carbonized at oven-coke plants in the United States, by State

State	1973	1974
Alabama	$17.24	$33.94
California, Colorado, Utah	16.26	34.65
Illinois	16.14	32.83
Indiana	18.39	37.03
Kentucky, Missouri, Tennessee, Texas	17.71	32.83
Maryland and New York	22.59	42.70
Michigan	21.30	44.29
Minnesota and Wisconsin	21.29	38.68
Ohio	17.56	34.89
Pennsylvania	17.95	36.44
West Virginia	15.10	30.45
Average	18.32	36.49
Value of coal per ton of coke	26.75	53.28

Table 26.—Average volatile content of bituminous coal carbonized by oven-coke plants in the United States

(Thousand short tons)

Year	High		Medium		Low		Total	
	Quantity	Volatile content (percent)	Quantity	Volatile content (percent)	Quantity	Volatile content (percent)	Quantity	Volatile content (percent)
1970	62,703	34.0	11,660	26.3	20,217	17.2	[1] 94,581	29.4
1971	53,542	35.1	12,085	25.2	15,904	18.3	81,531	30.4
1972	60,536	34.7	8,754	26.4	16,923	16.8	86,213	30.3
1973	64,486	34.6	10,090	26.6	17,762	16.2	92,338	30.2
1974	61,344	34.8	10,763	25.6	16,303	17.9	88,410	30.6

[1] Data do not add to total shown because of independent rounding.

Table 27.—Coal received by oven-coke plants in the United States in 1974, by consuming State and volatile content[1]

Consuming State	High-volatile		Medium-volatile		Low-volatile		Total coal receipts [2]
	Quantity	Percent of total	Quantity	Percent of total	Quantity	Percent of total	
Alabama	2,690	37.1	3,988	54.9	579	8.0	7,257
California, Colorado, Utah	4,122	81.3	409	8.0	542	10.7	5,072
Illinois	2,381	79.6	13	.4	599	20.0	2,992
Indiana	8,713	64.5	1,598	11.8	3,191	23.7	13,501
Kentucky, Missouri, Tennessee, Texas	2,149	78.4	324	11.8	269	9.8	2,743
Maryland and New York	6,471	67.5	403	4.2	2,718	28.3	9,592
Michigan	2,718	69.7	222	5.7	958	24.6	3,898
Minnesota and Wisconsin	489	51.2	157	16.5	309	32.3	956
Ohio	10,083	76.8	443	3.4	2,598	19.8	13,124
Pennsylvania	16,511	68.9	2,500	10.4	4,970	20.7	23,981
West Virginia	4,069	81.4	83	1.7	846	16.9	4,999
Total 1974 [2]	60,397	68.5	10,140	11.5	17,578	20.0	88,115
At merchant plants	3,333	48.4	1,277	18.6	2,267	33.0	6,877
At furnace plants	57.064	70.4	8.863	10.7	15,311	18.9	81,239
Total 1973	61,023	67.2	11,438	12.6	18,301	20.2	90,763

[1] Volatile matter on moisture-free basis: High-volatile—over 31%; medium-volatile—22% to 31%; and low-volatile—14% to 22%.

[2] Data may not add to totals shown because of independent rounding.

Table 28.—Origin of coal received by oven-coke plants in the United States in 1974, by producing county and volatile content[1]

(Thousand short tons)

Source of coal	Volatile content			Total[2]
	High	Medium	Low	
Alabama:				
Bibb	327	--	--	327
Blount	12	149	--	161
Jefferson	1,439	3,655	--	5,094
Marion	119	--	--	119
Tuscaloosa	--	27	--	27
Walker	591	124	--	715
Arkansas: Sebastian	--	--	178	178
Colorado:				
Delta	6	--	--	6
Gunnison	1,008	--	--	1,008
Las Animas	540	--	--	540
Pitkin	--	399	486	885
Illinois:				
Franklin	1,521	--	--	1,521
Jefferson	2,357	--	--	2,357
Saline	157	--	--	157
Kentucky:				
Bell	47	--	--	47
Breathitt	20	--	--	20
Clay	200	--	--	200
Floyd	2,273	--	--	2,273
Grayson	25	--	--	25
Greenup	91	--	--	91
Harlan	4,202	--	--	4,202
Henderson	14	--	--	14
Knott	149	--	--	149
Knox	132	--	--	132
Laurel	16	--	--	16
Leslie	31	--	--	31
Letcher	2,870	--	--	2,870
Madison	71	--	--	71
Magoffin	14	--	--	14
Perry	523	--	--	523
Pike	3,870	--	--	3,870
Whitley	16	--	--	16
Maryland: Garrett	--	--	7	7
New Mexico: Colfax	925	--	--	925
Ohio: Jackson	41	--	--	41
Oklahoma:				
Haskell	--	175	--	175
Le Flore	--	--	3	3
Pittsburgh	7	--	--	7
Rogers	158	--	--	158
Pennsylvania:				
Anthracite	--	--	493	493
Bituminous:				
Allegheny	2,436	--	--	2,436
Butler	63	--	--	63
Cambria	--	1,034	2,802	3,836
Clarion	--	39	--	39
Clearfield	--	8	80	89
Fayette	167	--	1	167
Greene	5,081	--	--	5,081
Indiana	79	5	--	84
Jefferson	--	--	13	13
Lycoming	--	--	41	41
Mercer	24	--	3	28
Somerset	--	6	1,729	1,735
Washington	9,917	--	--	9,917
Westmoreland	821	11	--	832
York	--	--	10	10
Tennessee:				
Campbell	20	--	--	20
Claiborne	105	--	--	105
Scott	44	--	--	44
Utah: Carbon	1,863	--	--	1,863
Virginia:				
Buchanan	300	555	1,748	2,602
Dickenson	333	--	--	333
Russell	4	427	--	431
Tazewell		83	--	83
Wise	1,107	--	--	1,107
West Virginia:				
Barbour	105	--	--	105
Boone	2,250	--	--	2,250
Cabell	6	--	--	6

See footnotes at end of table.

Table 28.—Origin of coal received by oven-coke plants in the United States in 1974, by producing county and volatile content [1]—Continued

(Thousand short tons)

Source of coal	Volatile content			Total [2]
	High	Medium	Low	
West Virginia—Continued:				
Fayette	1,700	65	558	2,322
Gilmer	90	--	--	90
Grant	--	31	--	31
Greenbrier	--	46	--	46
Harrison	--	50	--	50
Kanawha	2,071	--	--	2,071
Logan	4,760	162	--	4,922
McDowell	--	1,031	5,385	6,415
Marion	400	--	--	400
Mercer	--	--	600	600
Mineral	--	--	45	45
Mingo	1,464	17	--	1,482
Monongalia	212	--	--	212
Nicholas	444	775	--	1,218
Raleigh		192	1,095	1,287
Randolph	55	51	--	106
Summers	26	--	--	26
Upshur	104	--	--	104
Webster	11	108	--	118
Wyoming	564	358	1,875	2,797
Canada: Alberta	--	9	239	248
Germany, West: Ruhr	--	547	190	737
Total [2]	60,397	10,140	17,578	88,115

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[1] Volatile matter on moisture-free basis; high-volatile—over 31%; medium-volatile—22% to 31%; and low-volatile—14% to 22%.

[2] Data may not add to totals shown because of independent rounding.

Table 29.—Origin of coal received by oven-coke plants in the United States in 1974, by State

(Thousand short tons)

Consuming State	Producing State: Alabama	Arkansas	Colorado	Illinois	Kentucky	Maryland	New Mexico	Ohio	Oklahoma
Alabama	5,843	--	--	--	169	--	--	--	--
California, Colorado, Utah	--	--	2,422	--	--	--	925	--	--
Illinois	--	178	--	1,060	1,122	--	--	--	--
Indiana	231	--	11	2,971	3,243	--	--	--	--
Kentucky, Missouri, Tennessee, Texas	324	--	--	--	--	--	--	--	333
Maryland and New York	--	--	--	--	2,874	--	--	--	--
Michigan	6	--	6	--	1,259	--	--	--	7
Minnesota and Wisconsin	--	--	--	--	53	4	--	26	3
Ohio	32	--	--	5	2,497	--	--	15	--
Pennsylvania	--	--	--	--	2,511	4	--	--	--
West Virginia	7	--	--	--	835	--	--	--	--
Total 1974[1]	6,442	178	2,438	4,036	14,564	7	925	41	343
At merchant plants	551	--	--	--	213	--	--	--	3
At furnace plants	5,891	178	2,438	4,036	14,351	7	925	41	340
Total 1973	6,320	216	2,418	3,917	13,870	--	771	--	434

Consuming State	Producing State—Continued: Pennsylvania	Tennessee	Texas	Utah	Virginia	West Virginia	Canada	West Germany	Total[1]
Alabama	117	19	--	--	605	504	--	--	7,257
California, Colorado, Utah	56	--	--	1,649	20	-	--	--	5,072
Illinois	24	--	--	--	51	558	--	--	2,992
Indiana	1,543	44	--	--	548	4,901	9	--	13,501
Kentucky, Missouri, Tennessee, Texas	50	--	--	--	244	1,798	--	--	2,748
Maryland and New York	3,312	50	--	--	542	2,428	200	190	9,592
Michigan	48	25	--	125	195	2,228	--	--	3,898
Minnesota and Wisconsin	97	--	--	88	134	512	38	--	956
Ohio	3,908	21	--	--	1,014	5,637	--	--	13,128
Pennsylvania	13,565	5	--	--	1,068	6,282	--	547	23,981
West Virginia	2,150	4	--	--	138	1,865	--	--	4,999
Total 1974[1]	24,864	168	--	1,863	4,557	26,704	248	737	88,115
At merchant plants	600	35	--	2	945	4,526	--	--	6,877
At furnace plants	24,264	133	--	1,861	3,611	22,178	248	737	81,239
Total 1973	24,502	3	5	2,011	4,504	31,594	200	--	90,763

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[1] Data may not add to totals shown because of independent rounding.

Table 30.—Quantity and percentage of captive coal received by oven-coke plants in the United States

(Thousand short tons)

Year	At merchant plants			At furnace plants			Total[1]		
	Total coal received	Captive coal		Total coal received	Captive coal		Total coal received	Captive coal	
		Quantity	Percent		Quantity	Percent		Quantity	Percent
1970	7,866	2,320	29.5	86,869	51,379	59.2	94,735	53,699	56.7
1971	5,284	2,235	42.3	74,113	44,319	59.8	79,397	46,554	58.6
1972	7,804	2,325	29.8	80,158	45,354	56.7	87,962	47,679	54.3
1973	r 6,820	r 1,728	r 25.3	r 83,943	47,412	r 56.5	r 90,763	49,134	54.1
1974	6,877	1,520	22.1	81,239	44,116	54.3	88,115	45,637	51.8

r Revised.

[1] Data may not add to totals shown because of independent rounding.

Table 31.—Month-end stocks of bituminous coal at oven-coke plants in the United States

(Thousand short tons)

Month	1973	1974
January	8,498	6,269
February	8,381	7,205
March	8,489	7,553
April	8,500	7,659
May	8,821	7,796
June	8,544	7,576
July	6,059	7,671
August	6,498	7,588
September	6,575	7,402
October	7,097	7,572
November	7,171	6,482
December	[1]6,825	6,037

[1] Revised to reflect inventory adjustments.

Table 32.—Month-end stocks of anthracite coal at oven-coke plants in the United States

(Thousand short tons)

Month	1973	1974
January	80	85
February	62	76
March	46	70
April	45	65
May	53	89
June	52	78
July	54	78
August	60	119
September	66	151
October	78	164
November	97	170
December	[1]123	172

[1] Revised to reflect inventory adjustments.

Table 33.—Coal-chemical materials, exclusive of breeze, produced at oven-coke plants in the United States in 1974[1]

Product	Produced	Sold			On hand Dec. 31
		Quantity	Value		
			Total (thousands)	Average per unit	
Tar, crude ---------- thousand gallons --	677,447	333,623	$103,830	$0.311	47,221
Tar derivatives:					
Sodium phenolate or carbolate - do ----	2,596	2,515	249	.099	113
Crude chemical oil (tar acid oil) do ----	6,059	6,104	1,752	.287	112
Pitch of tar:[2]					
Soft ------ thousand short tons --	464	171	14,047	82.146	6
Hard -------------------- do ----	(2)	(2)	(2)	(2)	(2)
Other tar derivatives:[3] -------------	--	--	15,914	--	--
Ammonia products:					
Sulfate ------- thousand short tons --	547	552	36,678	66.446	24
Liquor (NH3 content) ------ do ----	7	6	497	82.833	1
Diammonium phosphate ------ do ----	(4)	(4)	(4)	(4)	(4)
Total -------------------- do ----	--	--	37,175	--	--
Sulfate equivalent of all forms - do ----	572	576	--	--	28
NH3 equivalent of all forms -- do ----	147	148	--	--	7
Gas:					
Used under boilers, etc million cubic feet --	[5]967,244	116,029	44,875	.387	--
Used in steel or allied plants - do ----		396,671	212,177	.535	--
Distributed through city mains - do ----		11,753	5,040	.429	--
Sold for industrial use ------- do ----		49,578	37,009	.746	--
Total[6] -------------------- do ----	[5]967,244	574,032	299,102	.521	--
Crude light oil ------ thousand gallons --	[7]217,416	95,439	39,761	.417	8,983

See footnotes at end of table.

Table 33.—Coal-chemical materials, exclusive of breeze, produced at oven-coke plants in the United States in 1974[1]—Continued

Product	Produced	Sold			On hand Dec 31
		Quantity	Value		
			Total (thousands)	Average per unit	
Light oil derivatives:					
Benzene:					
Specification grades (1°, 2°, 90%) Thousand gallons	82,149	83,114	$63,442	$.763	3,265
Other industrial grades ____ do	(8)	(8)	(8)	(8)	101
Toluene (all grades) ____ do	13,567	13,105	6,981	.533	1,362
Xylene (all grades) ____ do	3,135	3,050	1,677	.550	287
Solvent naphtha (all grades) ____ do	2,736	2,643	700	.265	207
Other light-oil derivatives ____ do	3,855	2,640	853	.323	269
Total[6] ____ do	105,443	104,552	73,654	.705	5,491
Intermediate light oil ____ do	5,070	1,811	384	.212	122
Grand total[8]	--	--	585,866	--	--

[1] Includes products of tar distillation conducted by oven-coke operators under the same corporate names.

[2] Soft-water-softening point-less than 110° F; medium-110° to 160° F; hard-oven 160° F. Figures on hard pitch includes small amount of medium pitch, and also include hard pitch to avoid disclosing individual company confidential data.

[3] Creosote oil, cresols, cresylic acid, naphthalene, phenol, pyridine, refined tar, tar paint.

[4] Included with sulfate to avoid disclosing individual company confidential data.

[5] Includes gas used for heating ovens and gas wasted.

[6] Data may not add to totals shown because of independent rounding.

[7] Includes 121,363,000 gallons refined by coke-oven operators to make derived products shown.

[8] Included with "Specification grades" to avoid disclosing individual company confidential data.

Table 34.—Coal equivalent of the thermal materials, except coke, produced at oven-coke plants in the United States

Year	Materials produced				Estimated equivalent in heating value[1] (Billion Btu)					Coal equivalent (thousand short tons)
	Coke breeze (thousand short tons)	Surplus gas (billion cubic feet)	Tar (thousand gallons)	Light oil (thousand gallons)	Coke breeze	Surplus gas	Tar	Light oil	Total	
1970	4,665	585	760,926	244,107	93,300	321,750	114,139	31,734	560,923	21,409
1971	4,048	507	679,377	201,626	80,960	278,850	101,907	26,211	487,928	18,628
1972	4,261	534	747,186	214,201	85,220	293,700	112,078	27,846	518,844	19,803
1973	4,902	r 596	732,455	226,110	98,040	r 327,800	109,868	29,394	r 565,102	r 21,569
1974	5,094	574	677,447	217,416	101,880	315,700	101,617	28,264	547,461	20,896

r Revised.

[1] Breeze, 10,000 Btu per pound; gas, 550 Btu per cubic foot; tar, 150,000 Btu per gallon; and light oil, 130,000 Btu per gallon.

Table 35.—Average value of coal-chemical materials used or sold and of coke and breeze per short ton of coal carbonized in the United States

	1970	1971	1972	1973	1974
Ammonia products	$0.151	$0.136	$0.141	$0.177	$0.418
Light oil and its derivatives	.405	.365	.350	.418	1.276
Surplus gas used or sold	1.561	1.640	1.660	2.052	3.366
Tar and its derivatives (including naphthalene):					
Tar burned by producers[1]	.398	.341	.366	.572	.753
Sold	.623	.721	.720	.611	1.528
Total	3.138	3.203	3.237	3.830	[2]7.342
Coke produced[3]	19.208	21.135	22.978	26.315	50.005
Breeze produced	.481	.534	.533	.558	1.022
Grand total	22,827	24.872	26.748	r 30.703	58.369

r Revised.

[1] Includes pitch-of-tar.

[2] Data do not add to total shown because of independent rounding.

[3] Average value of coke used or sold.

Table 36.—Percentage of coal costs recovered from the recovery of coal-chemical materials in the United States

	1970	1971	1972	1973	1974
Product:					
Ammonia products	1.3	1.1	1.0	1.0	1.2
Light oil and its derivatives	4.3	3.8	3.2	2.3	3.5
Surplus gas used or sold	12.8	11.7	10.6	11.2	9.2
Tar and its derivatives used or sold (including naphthalene)	9.0	8.0	8.0	6.5	6.3
Total	27.4	24.6	22.8	21.0	20.2
Value of coal per short ton	$12.21	$14.00	$15.74	$18.32	$36.49

Table 37.—Production and disposal of coke-oven gas in the United States in 1974, by State

(Million cubic feet)

State	Produced		Used in heating ovens	Surplus used or sold			Wasted
					Value		
	Total	Thousand cubic feet per ton of coal		Quantity	Thousands	Average per thousand cubic feet	
Alabama	75,357	10.30	33,987	39,561	$11,556	$0.292	1,809
California, Colorado, Utah	71,392	13.44	22,209	48,973	14,728	.301	210
Illinois	30,245	10.04	13,409	15,711	5,498	.350	1,125
Indiana	148,845	10.83	62,314	85,725	41,596	.485	806
Kentucky, Missouri, Tennessee, Texas	27,307	9.77	14,085	12,046	4,080	.339	1,176
Maryland and New York	99,651	10.70	38,343	59,545	41,075	.690	1,762
Michigan	53,960	11.91	8,988	44,451	17,631	.397	521
Minnesota and Wisconsin	14,095	10.83	6,851	6,563	2,318	.353	681
Ohio	140,452	10.83	54,334	83,625	38,290	.458	2,493
Pennsylvania	246,514	10.58	106,570	139,108	107,194	.771	835
West Virginia	59,427	11.29	19,832	38,725	15,148	.391	869
Total 1974[1]	967,244	10.89	380,923	574,032	299,102	.521	12,290
At merchant plants	64,721	9.15	31,927	30,926	9,246	.299	1,868
At furnace plants	902,524	11.04	348,996	543,106	289,856	.534	10,422
Total 1973	994,916	10.72	383,163	595,918	190,024	.319	15,835

[1] Data may not add to totals shown because of independent rounding.

Table 38.—Surplus coke-oven used by producers in the United States and sold in 1974, by State

(Million cubic feet)

State	Used by producers					
	Under boilers, etc.			In steel or allied plants		
	Quantity	Value		Quantity	Value	
		Thousands	Average per thousand cubic feet		Thousands	Average per thousand cubic feet
Alabama	12,469	$3,750	$0.301	23,645	$7,125	$0.301
California, Colorado, Utah	(1)	(1)	(1)	(1)	(1)	(1)
Illinois	3,514	1,249	.355	11,025	3,840	.348
Indiana	14,581	5,460	.374	68,221	34,616	.507
Kentucky, Missouri, Tennessee, Texas	5,970	2,263	.379	851	300	.353
Maryland and New York	1,209	544	.450	52,932	38,541	.728
Michigan	(1)	(1)	(1)	(1)	(1)	(1)
Minnesota and Wisconsin	5,824	2,162	.371	--	--	--
Ohio	10,239	3,551	.347	69,047	32,901	.477
Pennsylvania	19,758	13,294	.673	83,299	60,582	.727
West Virginia	(1)	(1)	(1)	(1)	(1)	(1)
Undistributed	42,464	12,603	.297	87,651	34,271	.391
Total 1974 [2]	116,029	44,875	.387	396,671	212,177	.535
At merchant plants	12,489	3,600	.288	(3)	(3)	(3)
At furnace plants	103,540	41,275	.399	396,671	212,177	.535
Total 1973	98,919	31,340	.316	471,714	151,313	.321

State	Sold					
	Distributed through city mains			For industrial use		
	Quantity	Value		Quantity	Value	
		Thousands	Average per thousand cubic feet		Thousands	Average per thousand cubic feet
Alabama	--	--	--	(1)	(1)	(1)
California, Colorado, Utah	--	--	--	--	--	--
Illinois	--	--	--	(1)	(1)	(1)
Indiana	(1)	(1)	(1)	(1)	(1)	(1)
Kentucky, Missouri, Tennessee, Texas	--	--	--	(1)	(1)	(1)
Maryland and New York	(1)	(1)	(1)	(1)	(1)	(1)
Michigan	(1)	(1)	(1)	--	--	--
Minnesota and Wisconsin	--	--	--	(1)	(1)	(1)
Ohio	(1)	(1)	(1)	(1)	(1)	(1)
Pennsylvania	(1)	(1)	(1)	(1)	(1)	(1)
West Virginia	--	--	--	(1)	(1)	(1)
Undistributed	11,753	$5,040	$0.429	49,578	$37,009	$0.746
Total 1974 [2]	11,753	5,040	.429	49,578	37,009	.746
At merchant plants	4,935	2,080	.421	49,578	37,009	.746
At furnace plants	6,819	2,960	.434	(4)	(4)	(4)
Total 1973	12,135	4,519	.372	13,149	2,852	.217

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[1] Included with "Undistributed" to avoid disclosing individual company confidential data.
[2] Data may not add to totals shown because of independent rounding.
[3] Included with furnace plants to avoid disclosing individual company confidential data.
[4] Included with merchant plants to avoid disclosing individual company confidential data.

Table 39.—Coke-oven gas and other gases used in heating coke ovens in the United States in 1974, by State[1]

(Million cubic feet)

State	Coke-oven gas	Blast-furnace gas	Natural gas	Total coke-oven gas equivalent
Alabama	33,987	--	--	33,987
California, Colorado, Utah	22,209	--	49	22,258
Illinois	13,409	1,116	--	14,525
Indiana	62,314	3,199	1,566	67,079
Kentucky, Missouri, Tennessee, Texas	14,085	66	20	14,171
Maryland and New York	38,343	6,631	482	45,456
Michigan	8,988	11,866	--	20,854
Minnesota and Wisconsin	6,851	--	--	6,851
Ohio	54,334	3,649	--	57,988
Pennsylvania	106,570	1,182	--	107,752
West Virginia	19,832	4,900	--	24,732
Total 1974[2]	380,923	32,609	2,118	[3]415,650
At merchant plants	31,927	--	--	31,927
At furnace plants	348,996	32,609	2,118	383,723
Total 1973	383,163	41,746	2,654	427,563

[1] Adjusted to an equivalent of 550 Btu per cubic foot.
[2] Data may not add to totals shown because of independent rounding.
[3] Equals 1,286 Btu per pound of coal carbonized.

Table 40.—Coke-oven tar produced in the United States, used by producers, and sold in 1974, by State

(Thousand gallons)

State	Produced		Used by producers[1]			Sold for refining into tar products			
							Value		
	Total	Gallons per ton of coal coked	For refining or topping	As fuel	Otherwise	Quantity	Thousand dollars	Average per gallon	On hand Dec. 31
Alabama	47,556	6.50	(2)	--	--	29,063	$7,980	$0.275	2,059
California, Colorado, Utah	47,801	9.00	(2)	(2)	--	29,841	7,008	.235	2,861
Illinois	19,728	6.55	(2)	(2)	(2)	16,067	4,192	.261	2,338
Indiana	101,377	7.38	(2)	28,980	--	35,258	11,784	.334	3,815
Kentucky, Missouri, Tennessee, Texas	17,588	6.29	--	--	(2)	17,680	5,122	.290	461
Maryland and New York	69,147	7.48	(2)	41,119	--	29,183	9,964	.341	6,473
Michigan	33,134	7.31	--	--	(2)	35,406	11,209	.317	3,036
Minnesota and Wisconsin	8,172	6.28	--	--	(2)	(3)	(3)	(3)	(3)
Ohio	103,046	7.95	(2)	49,372	(2)	53,375	18,168	.340	6,454
Pennsylvania	187,241	8.03	105,157	47,996	3,001	60,038	20,837	.347	17,277
West Virginia	42,660	8.11	(2)	--	--	27,716	7,572	.273	2,447
Undistributed	--	--	80,319	13,440	553	--	--	--	--
Total 1974[4]	677,447	7.62	185,476	180,907	3,556	333,623	103,830	.311	47,221
At merchant plants	39,578	5.60	(5)	--	--	38,372	10,038	.262	1,194
At furnace plants	637,869	7.80	185,476	180,907	3,556	295,251	93,792	.318	46,027
Total 1973	732,455	7.89	225,801	163,736	925	336,342	41,705	.124	50,771

[1] Includes 22,565,000 gallons purchased or received from affiliated plants for refining or ultimate use.
[2] Included with "Undistributed" to avoid disclosing individual company confidential data.
[3] Included with "Michigan" to avoid disclosing individual company confidential data.
[4] Data may not add to totals shown because of independent rounding.
[5] Included with furnace plants to avoid disclosing individual company confidential data.

Table 41.—Coke-oven ammonia produced in the United States and sold in 1974 by State

(Thousand short tons and thousand dollars)

State	Produced					Sold				On hand Dec. 31	
	Active plants [1]	Sulfate equivalent	Pounds per ton of coal coked	As sulfate [2]	As liquor (NH_3 content)	As sulfate		As liquor (NH_3 content)		As sulfate	As liquor (NH_3 content)
						Quantity	Value	Quantity	Value		
Alabama	7	66	18.05	66	--	67	3,121	--	--	1	--
California, Colorado, Utah	(3)	(3)	(3)	(3)	--	(3)	(3)	--	--	(3)	--
Illinois	4	23	15.27	23	--	24	1,310	--	--	1	--
Indiana and Michigan	5	111	14.54	102	(4)	[2]101	[2]13,156	(4)	(4)	6	(4)
Kentucky, Minnesota, Tennessee, Texas	3	17	15.57	10	(4)	5	286	(4)	(4)	(5)	(4)
Maryland and New York	3	88	19.83	87	(4)	85	4,927	(4)	(4)	3	(4)
Ohio	11	102	17.22	93	(4)	95	5,108	(4)	(4)	4	(4)
Pennsylvania	8	105	17.15	105	--	116	6,634	--	--	6	--
West Virginia	5	61	15.31	61	--	60	2,141	--	--	3	--
Undistributed	--	--	--	--	7	--	--	6	497	--	1
Total 1974 [6]	46	572	16.65	547	7	552	36,678	6	497	24	1
At merchant plant	8	572	18.22	17	7	17	834	6	497	(7)	1
At furnace plants	38	(8)	16.56	530	(8)	535	35,844	(8)	(8)	24	(8)
Total 1973	49	628	16.41	600	7	616	16,009	8	410	[9]29	1

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[1] Number of plants that recovered ammonia.
[2] Includes diammonium phosphate to avoid disclosing individual company confidential data.
[3] Included with "West Virginia" to avoid disclosing individual company confidential data.
[4] Included with "Undistributed" to avoid disclosing individual company confidential data.
[5] Less than 500 tons.
[6] Data may not add to totals shown because of independent rounding.
[7] Included with furnace plants to avoid disclosing individual company confidential data.
[8] Included with merchant plants to avoid disclosing individual company confidential data.
[9] Revised to reflect inventory adjustments.

Table 42.—Coke-oven crude light oil produced in the United States and derived products produced and sold in 1974, by State

(Thousand gallons)

State	Active plants[1]	Crude light-oil				Derived products		
		Produced	Gallons per ton of coal	Refined on premises[3]	On hand Dec. 31	Produced	Sold[2]	
							Quantity	Value (thousands)
Alabama	7	14,699	2.01	2,597	1,132	2,149	2,514	$1,461
California, Colorado, Utah	3	15,762	2.97	9,965	273	7,465	7,465	4,066
Illinois	4	7,048	2.34	35	273	--	--	--
Indiana and West Virginia	7	42,152	2.64	1,117	1,505	597	584	223
Kentucky, Michigan, Missouri, Tennessee, Texas	5	11,730	1.95	1,251	492	1,154	1,177	520
Maryland and New York	4	28,090	3.02	13,094	550	12,126	12,113	9,605
Ohio	11	30,979	2.42	17,222	1,833	14,837	14,872	9,707
Pennsylvania	10	66,956	2.96	76,082	2,924	67,118	65,829	48,071
Total 1974[4]	51	217,416	2.64	121,363	8,988	105,443	104,552	73,654
At merchant plants	6	8,034	1.84	([5])	701	([5])	([5])	([5])
At furnace plants	45	209,383	2,69	121,363	8,282	105,443	104,552	73,654
Total 1973	45	209,383	2.69	121,363	[6] 8,369	113,878	102,673	26,181

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[1] Number of plants that recovered crude light oil.
[2] Excludes 95,439,000 gallons of crude light oil valued at $39,761,000 sold as such.
[3] Includes small quantity of material also reported in the sales of crude light oil in table 33.
[4] Data may not add to totals shown because of independent rounding.
[5] Included with furnace plants to avoid disclosing individual company confidential data.
[6] Revised to reflect inventory adjustments.

Table 43.—Yield of light oil derivatives from refining crude light oil at oven-coke plants in the United States

(Percent)

Year	Benzene (all grades)	Toluene (all grades)	Xylene (all grades)	Solvent naphtha (crude and refined)	Other light oil products
1970	63.0	12.1	3.2	3.3	5.2
1971	65.6	12.4	2.8	3.2	5.0
1972	59.3	12.8	3.1	3.0	4.7
1973	61.2	11.3	2.8	2.7	5.5
1974	60.2	11.5	2.7	2.9	4.7

Table 44.—Benzene and toluene produced at oven-coke plants in the United States, by grade

(Thousand gallons)

Year	Benzene		Toluene (all grades)
	Specification grades (1°, 2°, 90%)	Other industrial grades	
1970	89,517	3,975	17,401
1971	68,756	3,391	13,345
1972	76,317	3,532	14,571
1973	85,876	3,299	14,496
1974	82,149	([1])	13,567

[1] Included with 'Specification grades" to avoid disclosing individual company confidential data.

Table 45.—Light oil derivatives produced at oven-coke plants in the United States and sold in 1974, by State

(Thousand gallons and thousand dollars)

State	Benzene (all grades)				Toluene (all grades)			
	Produced	Yield from crude light oil refined (percent)	Sold		Produced	Yield from crude light oil refined (percent)	Sold	
			Quantity	Value			Quantity	Value
Alabama	7,040	56.6	1,783	4,504	1,534	13.2	1,499	691
Colorado, Indiana, Utah	(1)	(1)	5,787	(1)	(1)	(1)	(1)	(1)
Maryland, Tennessee, Texas	12,677	88.6	12,772	9,918	344	2.7	266	133
Ohio	11,874	62.6	12,037	8,327	2,107	12.2	2,061	1,079
Pennsylvania	50,557	55.7	50,784	40,699	9,582	12.7	9,278	5,079
Total 1974 [2] [3]	82,149	60.2	83,114	63,442	13,567	11.5	13,105	6,981
Total 1973	89,175	61.2	78,987	21,042	14,496	11.3	14,127	3,160

State	Xylene (all grades)				Solvent naphtha (crude and refined)			
	Produced	Yield from crude light oil refined (percent)	Sold		Produced	Yield from crude light oil refined (percent)	Sold	
			Quantity	Value			Quantity	Value
Alabama	350	2.8	339	155	443	4.2	345	89
Colorado, Indiana, Utah	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)
Maryland, Tennessee, Texas	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)
Ohio	474	3.2	406	219	382	2.7	(4)	(4)
Pennsylvania	2,312	3.1	2,306	1,303	1,911	2.7	2,298	612
Total 1974 [2] [3]	3,135	2.7	3,050	1,677	2,736	2.9	2,643	700
Total 1973	3,104	2.8	3,040	689	2,806	2.7	2,514	513

[1] Included with Alabama to avoid disclosing individual company confidential data.

[2] Data may not add to totals shown because of independent rounding.

[3] Data not broken down into merchant and furnace plants to avoid disclosing individual company confidential data.

[4] Included with Pennsylvania to avoid disclosing individual company confidential data.

Columbium and Tantalum

By Henry E. Stipp [1]

Consumption of columbium in 1974 increased 14% over that of 1973 to a new record high totaling about 4.6 million pounds of contained columbium and tantalum. Consumption was in the form of ferrocolumbium, ferrotantalum-columbium, and other columbium and tantalum materials. Columbium and tantalum are used in steel to stabilize carbon and nitrogen, improve the yield strength, decrease weight, and increase the weldability. Columbium steels are being used increasingly for applications in pipelines, automobiles, railroads, heavy equipment, construction, and shipbuilding.

Demand for tantalum in the first three quarters of 1974 increased substantially, resulting in record high prices for tantalum concentrates. Prices for columbium mineral concentrates also increased.

Imports of columbium and tantalum mineral concentrates (gross weight) increased 11% and 73%, respectively, over those of 1973. Ferrocolumbium imports, mainly from Brazil, increased 55% to 3,276,000 pounds, a record high compared with similar imports in 1973. Research on the use of columbium alloys as super-conductors of electricity at cryogenic temperatures received increasing attention.

Legislation and Government Programs.—The columbium and tantalum disposal program of the General Services Administration (GSA) continued with sales of 2,162,226 pounds of columbium concentrate (Cb content) and 394,122 pounds of tantalum minerals (Ta content). Several bills for disposing of additional quantities of stockpiled columbium and tantalum materials were submitted for congressional consideration.

GSA changed the conditions for sale of stockpile tantalum after a meeting with the U.S. Tantalum Producers Association on March 19. The new conditions of sale included a rule that no more than 25,000 pounds of contained tantalum would be awarded to any one firm or its affiliates. In addition, the buyer must guarantee that any tantalum bought from GSA will be consumed in the United States within 90 days of sale. Any resale of GSA material would be made under the new provisions.

Table 1.—Salient columbium statistics
(Thousand pounds)

	1970	1971	1972	1973	1974
United States:					
Mine production of columbite-tantalite concentrates	--	--	--	--	--
Releases from Government stocks (Cb content)[1]	1,042	36	799	2,344	2,162
Consumption of raw materials (Cb content)	3,289	2,346	2,489	2,806	3,250
Production of primary products:					
Columbium metal (Cb content)	W	W	W	W	W
Ferrocolumbium (Cb content)	1,430	1,020	1,474	1,496	1,174
Consumption of primary products:					
Columbium metal (Cb content)	261	459	218	254	221
Ferrocolumbium, ferrotantalum-columbium and other columbium and tantalum materials (Cb and Ta content)	2,591	2,880	3,676	4,056	4,626
Exports: Columbium metal, compounds, and alloys (gross weight)	46	21	29	96	33

See footnotes at end of table.

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[1] Physical scientist, Division of Ferrous Metals.

Table 1.—Salient columbium statistics—Continued

(Thousand pounds)

	1970	1971	1972	1973	1974
United States—Continued					
Imports for consumption:					
Mineral concentrate (Cb content)	2,505	1,289	1,558	1,314	1,471
Columbium metal and columbium-bearing alloys (Cb content)	2	1	1	4	1
Ferrocolumbium (Cb content) [e]	1,300	710	1,530	2,120	3,276
Tin slags (Cb content) [2]	498	526	547	603	460
World: Production of columbium-tantalum concentrates (Cb content) [e]	18,689	8,252	18,121	21,127	20,504

[e] Estimate. W Withheld to avoid disclosing individual company confidential data.

[1] Includes columbium content in raw materials from which columbium is not recovered and material released as payment-in-kind for upgrading.

[2] Receipts reported by consumers.

Table 2.—Salient tantalum statistics

(Thousand pounds)

	1970	1971	1972	1973	1974
United States:					
Mine production of columbium-tantalum concentrates	--	--	--	--	--
Releases from Government stocks (Ta content) [1]	161	6	87	266	394
Consumption of raw materials (Ta content)	1,733	1,116	1,280	2,221	2,425
Production of primary metal (Ta content)	916	892	1,352	1,619	944
Consumption of primary products:					
Tantalum metal (Ta content)	417	649	922	1,096	1,159
Ferrocolumbium and ferrotantalum-columbium and other columbium and tantalum materials (Cb and Ta content)	2,591	2,880	3,676	4,056	4,626
Exports:					
Tantalum ore and concentrate (gross weight)	122	48	19	16	201
Tantalum metal, compounds, and alloys (gross weight)	640	194	146	344	503
Tantalum and tantalum alloy powder (Ta content)	189	85	171	202	233
Imports for consumption:					
Mineral concentrate (Ta content)	448	502	458	428	721
Tantalum metal and tantalum-bearing alloys (Ta content)	51	40	74	101	184
Tin slags (Ta content) [2]	470	481	625	719	760
World: Production of columbium-tantalum concentrates (Ta content) [e]	701	1,093	818	[r] 845	1,411

[e] Estimate. [r] Revised.

[1] Includes material released as payment-in-kind for upgrading.

[2] Receipts reported by consumers.

Table 3.—Columbium and tantalum materials in Government inventories as of Dec. 31, 1974

(Thousand pounds, columbium and tantalum content)

Material	Objective	National (strategic) stockpile	Defense Production Act (DPA) Inventory	Supplemental stockpile	Total
Columbium:					
Concentrates	--	2,160	175	10	2,345
Carbide powder: Stockpile grade	16	21	--	--	21
Ferrocolumbium:					
Stockpile grade	748	[1] 748	--	--	[1] 748
Nonstockpile grade	--	183	--	--	183
Metal: Stockpile grade	36	45	--	--	45
Tantalum:					
Tantalum minerals: Stockpile grade	312	2,588	85	1	2,674
Carbide powder: Stockpile grade	3	29	--	--	29
Metal: Stockpile grade	45	201	--	--	201

[1] Includes 149,590 pounds of nonstockpile-grade material.

DOMESTIC PRODUCTION

There was no domestic production of columbium and tantalum minerals reported during the year.

Columbium metal powder produced in 1974 decreased 19% compared with that of 1973. However, specific data is withheld to avoid disclosing confidential company information. Columbium metal ingot production, also withheld to avoid disclosing confidential company data, decreased 4% compared with that in 1973. Tantalum metal powder production (including capacitor-grade powder) increased 14% to 925 tons compared with 810 tons in 1973. Tantalum metal ingot production totaled 356 tons, the same as that of 1973.

Ferrocolumbium was produced in 1974 by three companies.

Table 4.—Major domestic columbium and tantalum processing and producing companies in 1974

Company	Location	Columbium	Tantalum	Tantalum carbide	Ferro-columbium
Allegheny-Ludlum Industries, Inc	Marengo, Ill Brackenbridge, Pa Watervliet, N.Y	X	X	--	--
Fansteel, Inc	Chicago, Ill Muskogee, Okla	X	X	X	--
General Electric Co	Warren, Mich	--	--	X	--
Kawecki Div., Kawecki Berylco Industries, Inc	Boyertown, Pa	X	X	X	X
Kennametal, Inc	Latrobe, Pa	X	X	X	--
Mallinckrodt Chemical Works	St. Louis, Mo	X	X	--	--
Mining and Metals Div., Union Carbide Corp	Marietta, Ohio Greenville, S.C	X	X	--	--
Molybdenum Corp. of America	Washington, Pa	X	--	--	--
Metals Div., Norton Co	Newton, Mass	X	X	X	--
Newcomer Products, Inc	Latrobe, Pa	X	--	X	--
Reading Alloys Co., Inc	Robesonia, Pa	X	--	--	X
Shieldalloy Corp	Newfield, N.J	X	--	--	X
Wah Chang Albany (a Teledyne company)	Albany, Oreg	X	X	X	--

CONSUMPTION AND USES

Columbium consumed in the form of high-purity metal decreased 13% to 220,696 pounds compared with 253,882 pounds in 1973. The primary end use for high-purity columbium metal, in powder and ingot form, was in high-temperature superalloys required mainly by the aerospace industry.

Consumption of tantalum metal, including capacitor-grade powder, increased 6% to 1,159,201 pounds compared with 1,095,694 pounds in 1973. The principal end use for tantalum metal, in powder and ingot form, was in the manufacture of capacitors and other electronic equipment, and corrosion-resistant chemical equipment.

Ferrocolumbium, ferrotantalum-columbium, and other columbium and tantalum materials consumed in steelmaking increased 4% to a total 3,388,601 pounds of contained columbium and tantalum compared with 3,253,822 pounds in 1973.

Columbium and tantalum in the form of ferroalloys, added to steels to control grain size and improve strength and weldability, accounted for 73% of the total consumption of ferrocolumbium, ferrotantalum-columbium, and other columbium and tantalum materials. Consumption of ferrocolumbium, ferrotantalum-columbium, and other columbium and tantalum materials increased in all end-use categories except stainless and heat-resisting steel. Consumption in that category decreased 21% from that of 1973.

Domestic consumption of columbium and tantalum in ferroalloy forms, by major end-use categories, was as follows: High-strength, low-alloy steels, 27%; superalloys, 24%; carbon steel, 22%; stainless and heat-resisting steel, 12%; and full alloy, 11%. Consumption of ferrotantalum-columbium continued to be negligible; it accounted for less than 1% of the total consumption of columbium and tantalum in the form of ferrocolumbium, ferrotantalum-columbium, and other columbium and tantalum materials. The major end use for ferrotantalum-columbium was in stainless and heat-resisting steel.

Demand for columbium in alloy plate steel for use in oil and gas pipelines was expected to increase significantly during the next few years. Columbium in the form of ferrocolumbium is added to pipeline and heavy-plate steels to increase low-temperature strength and toughness.

High-strength, low-alloy steel used in automobiles currently totals about 70 pounds per vehicle. It is estimated that by 1980 approximately 200 pounds per vehicle would be used in order to make cars lighter but stronger.[2]

A columbium-germanium alloy reportedly has potential for use in electrical power transmission cables, electric magnets for fusion reactors, rotating electrical machinery, train and ship propulsion devices, generators, and low-power electrical devices.

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[2] The Northern Miner (Toronto). Columbium. V. 60, No. 47, Feb. 6, 1975, p. 11.

Table 5.—Reported shipments of columbium and tantalum materials

(Pounds of metal content)

Material	1973	1974	Change (percent)
Columbium products:			
Compounds, including alloys	1,216,800	1,520,500	+25
Metal, including worked products	143,000	133,400	−7
All other	300	34,000	+11,233
Total columbium	1,360,100	1,687,900	+24
Tantalum products:			
Oxides and salts	142,300	226,100	+59
Alloy additive	17,300	24,800	+43
Carbide	173,400	163,400	−6
Powder and anodes	790,500	929,400	+18
Ingot (unworked consolidated metal)	16,000	1,700	−89
Mill products	321,200	288,800	−10
Scrap	40,500	45,600	+13
Other	1,300	1,300	--
Total tantalum	1,502,500	1,681,100	+12

Source: Tantalum Producers Association.

Table 6.—Consumption of ferrocolumbium, ferrotantalum-columbium, and other columbium and tantalum materials in the United States in 1974, by end use

(Pounds)

End use	Contained columbium and tantalum
Steel:	
Carbon	1,035,261
Stainless and heat-resisting	564,620
Full alloy	511,103
High-strength, low-alloy	1,256,137
Electric	W
Tool	21,480
Superalloys	1,097,635
Alloys (excluding alloy steels and superalloys)	82,766
Miscellaneous and unspecified	56,824
Total	4,625,826

W Withheld to avoid disclosing individual company confidential data; included in "Miscellaneous and unspecified."

STOCKS

Columbium and tantalum materials in processor and dealer inventories at yearend were as follows in pounds:

Material	Dec. 31, 1973	Dec. 31, 1974
COLUMBIUM		
Primary metal	108,697	89,203
Ingot	51,290	36,548
Scrap	80,025	112,817
Oxide	495,451	536,538
Other compounds	13,946	12,369
TANTALUM		
Primary metal	[r]220,525	213,855
Capacitor-grade powder	135,098	110,395
Ingot	65,088	82,620
Scrap	258,568	329,697
Oxide	37,101	69,580
Potassium tantalum fluoride	130,763	138,673
Other compounds	31,051	57,621

[r] Revised.

Stocks of columbium and tantalum raw materials, reported by processors and dealers at yearend 1974, in short tons (gross weight), 1973 figures in parentheses, were as follows: Columbite, 1,511 (1,310); tantalite, 1,079 (745); pyrochlore, 208 (229); and tin slag, 33,695 (34,691).

Ferrocolumbium and ferrotantalum-columbium stocks held by consumers as of December 31, 1974, were as follows (1973 yearend stocks in parentheses): Ferrocolumbium, 1,719,425 pounds of contained columbium (1,456,283); ferrotantalum-columbium, 10,837 pounds of contained columbium and tantalum (22,867); and other columbium and tantalum materials, 46,947 pounds of contained columbium and tantalum (47,182). Producer stocks of ferrocolumbium at yearend 1974 were 946,400 pounds of contained columbium (774,800).

PRICES

Prices for columbite and pyrochlore increased in 1974. Contract rates for Canadian pyrochlore, f.o.b. mine and mill, increased from $1.44 per pound of Cb_2O_5 to $1.80 per pound at yearend. Brazilian pyrochlore similarly increased from $1.42 per pound of CB_2O_5 content to $1.56. Columbite ore, c.i.f. U.S. ports, increased from $1.45 per pound of contained pentoxides for material having a CB_2O_5-to-Ta_2O_5 ratio of 10 to 1, to $1.80 per pound at yearend.

Tanco tantalite at the beginning of the year was quoted at $10 per pound of contained Ta_2O_5; by yearend, the price was $15. Spot prices for other tantalite ores or concentrates at the beginning of the year were quoted at $8.50 to $10 per pound of Ta_2O_5, 60% basis, c.i.f. U.S. ports; at yearend prices were $13 to $15.

At the beginning of the year, Thailand tin slag from the Union Carbide-Billiton tin smelter, 12%-Ta_2O_5 content, was quoted at $4.50 per pound of contained Ta_2O_5; at yearend, the price was $5.

Prices at the beginning of the year for various grades of ferrocolumbium per pound of contained columbium (ton lots, f.o.b. shipping point) were low-alloy grades, $3.10, and high-purity grades, $5.00 to $5.26. At yearend, prices had increased to $4.12 for low-alloy grades (15:1 ratio) and $8.61 to $8.65 for high-purity grades.

The price of columbium metal increased during the year. Columbium powder, reactor grade, was quoted at $12 to $23 per pound from January 1 to June 1, and $30 to $45 per pound through yearend. Reactor-grade columbium ingot was quoted at $17.50 to $28 from January 1 to June 1, and $18 to $25 through yearend.

Tantalum metal prices from January 1 to October 16 were quoted as follows: Powder, $30 to $37; rod, $30 to $40; and sheet, $36 to $60. Prices for tantalum metal from October 17 through yearend were as follows: Powder, $35.40 to $44.50; rod, $45 to $54; and sheet, $50 to $57.

Table 7.—Average grade of concentrate received by U.S. consumers and dealers in 1974, by country of origin

(Percent contained pentoxides)

	Columbite		Tantalite	
	Cb_2O_5	Ta_2O_5	Ta_2O_5	Cb_2O_5
Australia	--	--	46	27
Belgium	--	--	33	35
Brazil[1]	55	6	45	33
Canada	--	--	43	13
Congo	--	--	31	37
Germany, West	--	--	35	33
Malagasy, Republic	--	--	31	43
Malaysia	49	15	26	31
Mozambique	--	--	34	43
Netherlands	--	--	49	1
Nigeria	61	8	29	40
Portugal	--	--	34	35
Rhodesia, Southern	--	--	33	27
Rwanda	--	--	30	43
South Africa, Republic of	--	--	33	39
South-West Africa	--	--	71	10
Spain	--	--	32	33
Thailand	--	--	33	27
Zaire	--	--	30	41

[1] Material reported from Brazil as columbite represents primarily pyrochlore.

FOREIGN TRADE

U.S. exports of unwrought columbium and columbium alloys, and waste and scrap were shipped mainly to West Germany (43%), the United Kingdom (43%), and Japan (9%). Wrought columbium and columbium alloys went chiefly to West Germany (39%), Canada (21%), and Japan (15%).

U.S. exports of tantalum ores and concentrates were shipped chiefly to West Germany (54%) and Japan (45%). Wrought tantalum and tantalum alloys n.e.s., shipped from the United States in 1974 went mainly to Japan (33%), West Germany (19%), and the United Kingdom (19%). Unwrought tantalum metals and alloys, and waste and scrap shipped from the United States went mainly to West Germany (88%), Japan (7%), and Mexico (2%). U.S. exports of tantalum and tantalum-alloy powder went chiefly to Japan (32%), West Germany (21%), and the United Kingdom (19%).

Imports for consumption of unwrought columbium metal, and waste and scrap, from West Germany (64%) and the Netherlands (36%), totaled 481 pounds valued at $6,658. There were no imports of unwrought columbium alloys and wrought columbium metal in 1974.

Unwrought tantalum metal, and waste and scrap imported for consumption totaled 183,788 pounds valued at about $1.6 million; these imports were mainly from West Germany (43%), the United Kingdom (34%), and Mexico (17%). Unwrought tantalum alloys, all from West Germany, totaled 18 pounds valued at $979. Wrought tantalum, imported mainly from the United Kingdom (65%), totaled 376 pounds valued at $16,069.

Imports for consumption of columbium mineral concentrates and tantalum mineral concentrates in 1974 increased 11% and 73%, respectively, over 1973 imports.

Tin slag receipts in 1974 came chiefly from Thailand.

Table 8.—U.S. exports of columbium and tantalum, by class

(Thousand pounds, gross weight, and thousand dollars)

Class	1973		1974	
	Quantity	Value	Quantity	Value
Columbium and columbium alloys, unwrought, and waste and scrap	20	140	12	113
Columbium and columbium alloys, wrought	76	650	21	450
Tantalum ores and concentrates	16	13	201	467
Tantalum and tantalum alloys, wrought	44	2,368	54	3,038
Tantalum metals and alloys, in crude form and scrap	300	1,581	449	3,308
Tantalum and tantalum alloy powder	202	5,312	283	7,008

Table 9.—Receipts of tin slags reported by consumers

(Thousand pounds)

Year	Gross weight	Cb_2O_5 content	Ta_2O_5 content
1970	10,275	713	573
1971	9,064	753	596
1972	9,782	783	762
1973	8,607	863	878
1974	8,385	658	928

Table 10.—U.S. imports for consumption of columbium-mineral concentrates, by country

(Thousand pounds and thousand dollars)

Country	1972		1973		1974	
	Quantity	Value	Quantity	Value	Quantity	Value
Belgium-Luxembourg [1]	5	9	--	--	18	40
Brazil	2,347	1,363	2,361	1,686	2,349	1,958
Canada	65	52	1	1	9	8
Congo (Brazzaville)	--	--	17	54	--	--
Germany, West	2	2	39	13	100	282
Malaysia	75	44	232	154	204	401
Nigeria	648	362	67	60	328	301
Portugal	14	24	31	49	20	50
Rwanda	--	--	8	19	28	59
Spain	6	9	8	16	--	--
Thailand	--	--	--	--	55	51
Uganda	15	11	--	--	--	--
United Kingdom	50	51	--	--	--	--
Zaire	--	--	62	149	28	57
Total	3,227	1,927	2,826	2,201	3,129	3,207

[1] Presumably country of transshipment rather than original source.

Table 11.—U.S. imports for consumption of tantalum-mineral concentrates, by country
(Thousand pounds and thousand dollars)

Country	1972		1973		1974	
	Quantity	Value	Quantity	Value	Quantity	Value
Australia	404	852	325	986	90	394
Belgium-Luxembourg[1]	16	27	--	--	14	96
Brazil	362	787	206	482	159	563
Canada	119	416	236	832	789	3,571
Congo (Brazzaville)	33	78	--	--	11	33
French Guiana	--	--	3	5	--	--
Germany, West	48	109	--	--	113	173
Japan	--	--	--	--	98	426
Malaysia			--	--	135	293
Mozambique	30	65	--	--	35	207
Netherlands	--	--	--	--	30	297
Nigeria	3	2	--	--	--	--
Portugal	--	--	--	--	11	30
Rhodesia	--	--	--	--	2	4
Rwanda	66	81	39	49	70	187
South Africa, Republic of	--	--	12	20	3	9
Spain	5	9	58	117	100	302
Tanzania	--	--	--	--	17	57
Thailand	26	33	--	--	115	273
Uganda	2	1	--	--	12	30
United Kingdom	27	37	--	--	--	--
Zaire	88	166	218	367	93	224
Total	1,229	2,663	1,097	2,858	1,897	7,169

[1] Presumably country of transshipment rather than original source.

Table 12.—U.S. import duties

Tariff classification number	Article	Rate of duty per pound[1]
601.21	Columbium concentrate	Free.
601.42	Tantalum concentrate	Do.
607.80	Ferrocolumbium and ferrotantalum-columbium	5% ad valorem.
	Columbium:	
628.15	Unwrought, waste and scrap	Do.
628.20	Wrought	9% ad valorem.
628.17	Unwrought Cb alloys	7.5% ad valorem.
	Tantalum:	
629.05	Unwrought, waste and scrap	5% ad valorem.
629.10	Wrought	9% ad valorem.
629.07	Unwrought Ta alloys	7.5% ad valorem.
423.00	Columbium and tantalum chemicals	5% ad valorem.

[1] Not applicable to countries with centrally controlled economies.

WORLD REVIEW

Australia.—Tantalite-columbite mineralization in the Pilbara area of Northwestern Australia is confined to pegmatites associated with granitic rocks. Large pegmatite structures about 2,000 feet long, occurring as dikes and segregations within the granites and Archaean fringe rocks, carry tantalum, columbium, tin, lithium, beryllium, and rare-earth minerals. Pegmatites in the Wodgina, Tabba Tabba, Strelley, and Pilgangoora areas are intruded into jaspilites, quartzites, and slates and interbedded with massive and sheared amphibolites; they contain economic deposits of tantalite, columbite, and beryl. Total production of tantalite and columbite from the region was as follows, in tons (gross weight): Pilgangoora, 34.5; Strelley, 30.5; Tabba Tabba, 19.3; and Wodgina, 242.8.[3]

Brazil.—Brasimet Comercio e Industria S.A., a subsidiary of South American Consolidated Enterprises of the Hochschild Group, was developing its Catalão pyrochlore deposit located in the State of Goiás. A 1,000-ton-per-day mill to beneficiate the pyrochlore was being constructed near the deposit.[4]

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[3] Liddy, J. C. The Mineral Potential of North-Western Australia. Australian Min., v. 66, No. 6, June 1974, pp. 31–38.

Companhia Brasileira de Metalúrgia e Mineração (CBMM) reportedly began expanding its pyrochlore production capacity from its 1974 rate of 28 million pounds of Cb_2O_5 content per year to about 40 million pounds per year by yearend 1976. CBMM produced pyrochlore concentrate from a deposit near Araxá, which contains ore averaging 3.5% Cb_2O_5 content. The company processed about 50% of its production into ferrocolumbium at a plant in Araxá. CBMM is owned by Brazilian interests (50.5%), Molybdenum Corp. of America (33%), and Pato Consolidated Gold Dredging, Ltd. (16.5%).

Two reports were published that described the geology, mineralogy, reserves, mining, and beneficiation of pyrochlore and columbite-tantalite deposits in Brazil.[5]

Canada.—Indicated and proven ore reserves at the St. Lawrence Columbium and Metals Corp. deposit, Oka, Quebec, were increased from 7.4 million tons to a total of 25.4 million tons grading 0.43% Cb_2O_5. This resulted from the discovery of two additional pyrochlore ore zones in June 1973. St. Lawrence planned to increase mill output to 3,000 tons per day from the present 2,200 tons per day. The firm milled 328,344 tons of ore during the 6 months ended March 1974.[6]

The St. Honoré columbium deposit near Chicoutimi, Quebec, was scheduled for development by Niobec Inc. at an estimated capital cost of $12.7 million. Production of 5.5 million pounds of Cb_2O_5 was expected to begin in early 1976. Reserves were reported as 40 million tons of 0.76% Cb_2O_5 to a depth of 850 feet. Niobec Inc. is owned by Quebec Mining Exploration Co. (SOQUEM), a Quebec provincial corporation (50%), Teck Corp. Ltd. (25%), and Copperfields Mining Corp. Ltd. (25%).[7]

Canada's shipments of columbium concentrates in 1974 were valued at $6.5 million (preliminary) compared with $3.2 million in 1973. The bulk of Canada's columbium concentrate, containing from 51% to 54% Cb_2O_5, is exported to Europe for use in the steel industry. Some columbium concentrate is processed to ferrocolumbium by St. Lawrence Columbium and Metals Corp., Oka, Quebec; Masterloy Products Ltd., Gloucester, Ontario; and Fundy Chemical International Ltd., Surrey, British Columbia.[8]

Chemalloy Minerals Ltd. sold a 24.9% interest in its subsidiary, Tantalum Mining Corp. of Canada, Ltd., (TANCO) to Kawecki Berylco Industries, Inc., of the United States. Chemalloy retained 50.1% interest in Tantalum Mining. The Manitoba Development Corp., a provincial agency, owns 25% of Tantalum Mining.[9]

The Tanco mine and plant at Bernic Lake was shut down in June 1973 reportedly because of the low market price for tantalum concentrate, which was below Tanco's minimum price of $10 per pound of Ta_2O_5 content. Operations resumed in January 1974. Reserves of tantalite ore at Tanco's mine were reported at yearend 1974 as 1,261,469 tons averaging 0.221% Ta_2O_5. Shipments of tantalum concentrate from Canada in 1974 totaled 430,000 pounds Ta_2O_5 (preliminary) in concentrates valued at $3,646,000 compared with shipments of 170,582 pounds Ta_2O_5 valued at $1,164,749 in 1973.[10]

Mozambique.—Revolutionary disturbances were not expected to interrupt mining or shipping of tantalite ore and concentrate for long. An independent Mozambique reportedly will have to sell tantalum concentrate to obtain foreign currency.[11]

Thailand.—Shipments of tin slags from Thailand Smelting and Refining Co. Ltd.'s smelter were returning to normal in March after an interruption caused by the lack of steel drums. Thailand tin slags, which contain about 12% Ta_2O_5, were sold out under long-term contracts until 1977.[12]

Production of columbite and tantalite

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[4] Metal Bulletin. No. 5869, Feb. 14, 1974, p. 38.

[5] Neves, E. M. Perfil Analitico Do Pirocloro. Dept. Nacional da Produção Mineral, Bol. 18, 1973, 18 pp.

Costa, F. E. V.T. Baeta da. Perfil Analitico Da Columbita-Tantalita. Dept. Nacional da Produção Mineral, Bol. 9, 1973, 43 pp.

[6] The Northern Miner (Toronto). Columbium. V. 60, No. 37, Nov. 28, 1974, p. 91.

[7] The Northern Miner (Toronto). Copperfields and Soquem Join in New Columbium Project. V. 59, No. 50, Feb. 28, 1974, pp. 1, 15.

[8] Boucher, M. Columbium. Can. Dept. Energy, Mines and Res., Ottawa, Canada, 1974, 3 pp.

[9] The Wall Street Journal. Chemalloy Minerals Says Kawecki Will Buy Interest in Mining Unit. V. 183, No. 90, May 8, 1974, p. 28.

[10] Boucher, M. Tantalum. Can. Dept. Energy, Mines and Res. Ottawa, Canada, 1974, 3 pp.

[11] American Metal Market. Mozambique Fight Not Expected To Hurt Tantalite Ore Consumers. V. 81, No. 181, Sept. 17, 1974, p. 18.

[12] Metals Week. Tantalum Hits $10 Mark. V. 45, No. 10, Mar. 11, 1974, p. 6.

concentrates, recovered as a byproduct of tin mining, has been decreasing recently as a result of depletion of onshore tin mines, and the increasing cost of fuel. According to the Thailand Department of Mineral Resources, the number of tin mines in Thailand decreased by one-third during 1973, to 441 mines. A further decrease occurred in 1974. By contrast, production from large offshore dredging operations increased. During 1973, the number of offshore dredges increased from 6 to 10.[13]

United Kingdom.—Exports of ferrocolumbium from the United Kingdom were halted from February 18 as part of the Government export restrictions on iron and steel products.[14] The exports restrictions were imposed to safeguard United Kingdom steel and ferroalloy supplies, which have been reduced as a result of a coal strike. Reportedly, the ban would be lifted when steel and ferroalloy inventories have been increased to pre-strike levels.

TECHNOLOGY

Research in the field of superconductivity involving columbium alloys continued with new discoveries that could result in wider application for columbium materials. A chemical vapor deposition process was used to form a columbium-germanium alloy on a metallic or insulating substrate. Samples of columbium-germanium alloy previously were prepared for laboratory use by a sputtering process, which was not easily adaptable for commercial purposes. Columbium-germanium superconducting material can be prepared in commercial quantities using the chemical vapor process, thus facilitating practical application of the alloy.[15]

Oxidation studies on columbium-based alloys FS-85 and SU-31 and a disilicide coating established that neither alloy was entirely oxidation resistant and neither alloy could be used for gas turbine applications above 2,000° F without a protective coating. The disilicide coating protected both alloys against static oxidation for at least 200 hours at 1,600° F through 2,500° F.[16]

A new steel containing 0.06% columbium, 1.60% manganese, and 0.25% molybdenum was reported to have high strength, toughness, and weldability. The steel was designed for commercial applications that require yield strengths of 70,000 pounds to 100,000 pounds per square inch. Developed for pipelines subject to subzero arctic conditions, the columbium-manganese-molybdenum steel was able to maintain toughness well below 0° F.[17]

A stainless steel containing columbium and titanium that withstands temperatures of up to 300° C without developing corrosion cracks was developed by the Japanese Science and Technology Metal Material Research Center. The chromium ferrite-type steel contains no nickel; however, it has better heat conductivity than some stainless steels and can be used for pressure vessels, heat exchangers, and other high-pressure products.[18]

A high-purity tantalum evaporation filament was developed for resistance and RF/Bias evaporation of thin films by Materials Research Corp. The filaments, fabricated from electron-beam-refined tantalum, had low alkali impurity, consistent electrical properties, and maximum filament life.[19]

A study of the effect of carbon on the electrical resistivity of columbium and tantalum was reported. The electrical resistivity of columbium and tantalum, measured between 1,500° C and 2,100° C, increased linearly with the concentration of carbon within the alpha solid solution range.[20]

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[13] U.S. Embassy, Bangkok, Thailand. State Department Airgram A–284, Oct. 18, 1974, p. 4.

[14] Metal Bulletin. UK Exports Ban Shock. No. 5869, Feb. 14, 1974, p. 34.

[15] Science. Niobium-Germanium: Becoming a Practical Superconductor. V. 185, No. 4154, Sept. 6, 1974, pp. 846, 848.

[16] Journal of the Less-Common Metals. Oxidation of Columbium (Niobium) and Coated Columbium Alloys. V. 34, No. 2, February 1974, pp. 321–343.

[17] Metal Progress. New Pipeline Steel for Low Temperature Uses. V. 105, No. 4, April 1974, pp. 39–41.

[18] American Metal Market. Japanese Develop Stainless Steel Uncrackable at 300 Degrees C. V. 81, No. 109, June 5, 1974, p. 7.

[19] American Metal Market. Tantalum Filaments Designed for Thin Films. V. 77, No. 156, Aug. 14, 1970, p. 15.

[20] Journal of the Less-Common Metals. The Influence of Carbon on The Electrical Resistivity of Niobium and Tantalum. V. 35, No. 1, March 1974, pp. 77–84.

Table 13.—Columbium and tantalum: World production of mineral concentrates by country[1]

(Thousand pounds)

Country [2]	Gross weight [3]			Columbium content [4]			Tantalum content [4]		
	1972	1973	1974 [p]	1972	1973	1974 [p]	1972	1973	1974 [p]
Argentina:									
Columbite	[r] 1	3	[e] 3	[r] [5] ([6])	[5] 1	[5] [e] 1	[r] ([6])	1	[e] 1
Tantalite	[r] 4	2	[e] 2	[r] 1	([6])	[e] 1	[r] [5] 2	[5] 1	[5] [e] 1
Australia: Columbite-tantalite	558	441	[e] 441	121	96	[e] 96	[r] 201	163	[e] 163
Brazil:									
Columbite	143	373	[e] 485	36	73	[e] 112	36	113	[e] 179
Tantalite	660			134			216		
Pyrochlore	21,242	42,827	39,414	8,603	17,345	15,963	--	--	323
Canada:									
Tantalite	[e] 77	[r] [e] 318	[e] 802	3	13	32	[7] 34	[7] 140	[7] 352
Pyrochlore	[e] 7,756	[r] [e] 6,360	[e] 8,234	[7] 2,708	[7] 2,221	[7] 2,875	--	--	--
Malaysia: Columbite-tantalite	[r] 194	203	[e] 182	[r] 89	74	[e] 45	12	18	[e] 14
Mozambique:									
Tantalite	93	64	88	19	13	27	30	21	25
Microlite (tantalum concentrate)	134	123	117	5	5	5	74	68	64
Nigeria:									
Columbite	3,000	2,784	2,884	1,299	1,203	1,228	84	224	161
Tantalite	2	2		1	([6])		1	1	
Portugal: Tantalite	26	26	26	7	7	6	[5] 6	[5] 6	[5] 7
Rhodesia: Columbite-tantalite [e]	90	90	90	11	11	11	34	34	34
Rwanda: Columbite	84	72	[e] 73	24	22	[e] 22	20	17	[e] 18
South Africa, Republic of: Tantalite	([6])	--	--	([6])	--	--	([6])	--	--
Thailand:									
Columbite	[r] 11	18	68	[r] 5	6	23	[r] 1	2	7
Tantalite	[r] 20	35	134	[r] 4	7	25	[r] 5	9	36
Uganda: Columbite-tantalite	6	[e] 6	[e] 8	2	[e] 2	[e] 3	1	[e] 1	1
Zaire: Columbite-tantalite	214	102	102	49	28	29	61	26	25
	[r] 34,315	53,799	58,103	13,121	21,127	20,504	[r] 818	845	1,411

[e] Estimate. [p] Preliminary. [r] Revised.

[1] Excludes columbium and tantalum-bearing tin concentrates and slag.

[2] In addition to the countries listed, Burundi, Spain, South West Africa, and the U.S.S.R. also produce or are believed to produce columbium and tantalum mineral concentrates, but available information is inadequate to make reliable estimates of output levels.

[3] Data on gross weight generally has been presented as reported in sources, divided into concentrates of columbite, tantalite, pyrochlore and microlite where information is available to do so, and reported in groups such as columbite-tantalite where it is not.

[4] Unless otherwise specified, content is estimated on the basis of the content reported for United States imports from the country in question. Estimates specifically marked as estimates are based on estimated gross weights.

[5] Content calculated on the basis of data in source publication recording gross weight.

[6] Less than ½ unit.

[7] Content calculated in terms of metal from data reported in source publication in terms of contained pentoxide.

Tantalum carbide fiber grown by an alternating-current discharge method was studied. Maximum growth rates of up to 40 millimeters per minute were obtained with a minimum diameter of 3.5 microns. The tensile strength was 2.7 kilograms per square millimeter.[21]

The effect of oxygen on the corrosion of columbium and tantalum metal (99.9% pure) by liquid lithium at 600° C was studied. Lithium penetrated the metals when the oxygen concentration of the refractory metals exceeded a threshold level. Penetration resulted from formation of a ternary oxide, and proceeded by a wedging mechanism either intergranularly or along specific crystallographic planes, depending upon the oxygen concentration. The oxygen in the lithium did not increase the dissolution of the metals.[22]

An increasing interest in the recovery of columbium and tantalum from low-grade materials was shown by some of the patents issued in 1974.[23]

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[21] Journal of the Electrochemical Society. Fibrous Growth of Tantalum Carbide by A-C Discharge Method. V. 121, No. 5, May 1974, pp. 714–718.

[22] Metallurgical Transactions. Oxygen Effects on the Corrosion of Niobium and Tantalum by Liquid Lithium. V. 5, No. 4, April 1974, pp. 875–879.

[23] Scott, J. J. Recovery of Columbium and Tantalum Values From Tin Slag. U.S. Pat. 3,811,867, May 21, 1974.

Raby, R., and C. Desrochers (assigned to SOQUEM). Froth Flotation Beneficiation of Relatively Low-Grade Pyrochlore Ore Containing Large Quantities of Gangue Minerals. Brit. Pat. 1,356,915, June 19, 1974.

Copper

By Harold J. Schroeder [1] and George J. Coakley [1]

World mine production attained 8.10 million tons, a record high for the seventh consecutive year, but the 3% rate of growth was the smallest since 1971. Among the major producers, Chile, Poland, and Australia recorded significant increases in production while the United States and Zambia had reduced outputs. During the first half of the year a high level of demand for copper increased prices to record highs and stimulated production. However, during the second half of the year a worldwide recession reduced demand and caused a precipitous drop in prices, and a rapid buildup in stocks of copper. A series of production cutbacks near yearend was an attempt to seek a balance between supply and demand.

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[1] Physical scientist, Division of Nonferrous Metals.

Table 1.—Salient copper statistics

	1970	1971	1972	1973	1974
United States:					
Ore produced thousand short tons	257,729	242,656	266,881	289,998	293,443
Average yield of copper ---- percent	r 0.59	0.55	0.55	0.53	0.49
Primary (new) copper produced—					
From domestic ores, as reported by—					
Mines ---- short tons	1,719,657	1,522,183	1,664,840	1,717,940	1,597,002
Value - thousands	$1,984,484	$1,583,071	$1,704,796	$2,044,349	$2,468,964
Smelters -- short tons	1,605,265	1,470,815	1,649,130	1,705,065	1,532,066
Percent of world total	24	22	r 22	r 21	19
Refineries - short tons	1,521,183	1,410,523	1,680,412	1,698,337	1,420,905
From foreign ores, matte, etc., as reported by refineries ---- do	243,911	181,259	192,821	170,151	233,753
Total new refined, domestic and foreign do	1,765,094	1,591,782	1,873,233	1,868,488	1,654,658
Secondary copper recovered from old scrap only ---- do	504,071	r 445,157	458,194	486,214	483,432
Exports:					
Metallic copper ---- do	273,577	262,838	241,600	292,504	246,205
Refined ---- do	221,211	187,654	182,743	189,396	126,526
Imports, general:					
Unmanufactured ---- do	392,480	359,479	415,611	r 420,513	608,602
Refined ---- do	132,143	163,988	192,379	r 202,955	313,569
Stocks Dec. 31: Producers:					
Refined ---- do	130,000	75,000	57,000	37,000	101,000
Blister and materials in solution ---- do	340,000	303,000	281,000	265,000	324,000
Total ---- do	470,000	378,000	338,000	302,000	425,000
Consumption:					
Refined copper ---- do	2,043,303	2,019,507	2,238,867	2,437,048	2,194,168

See footnotes at end of table.

Table 1.—Salient copper statistics—Continued

	1970	1971	1972	1973	1974
Consumption—Continued					
Apparent consumption, primary copper short tons	1,585,000	1,623,000	1,901,000	1,902,000	1,778,000
Apparent consumption, primary and old copper (old scrap only) do	2,089,000	2,068,000	2,359,000	[r] 2,388,000	2,261,000
Price: Weighted average, cents per pound	58.2	52.0	51.2	59.5	77.3
World:					
Production:					
Mine short tons	6,638,042	6,688,634	[r] 7,321,950	[r] 7,848,266	8,104,695
Smelter do	6,751,531	6,591,741	[r] 7,404,601	[r] 7,931,807	8,148,472
Price: London, average cents per pound	62.96	48.49	48.53	80.86	93.13

[r] Revised.

In the United States consumption of refined copper and mine, smelter, and refinery outputs were all substantially smaller. Strikes at most producing units during portions of July and August and reduced demand for copper in the latter half of the year were factors that adversely affected the level of activity. Imported copper was a larger component of supply as imports of unmanufactured copper increased significantly while exports declined. An additional component of supply in 1974 resulted from the sale or commitment during the months of February through May of all of the approximately 252,000 tons of refined copper remaining in the national stockpile. Industrial stocks of refined copper increased since the supply of copper from production, net imports, and Government stockpile releases exceeded consumption. The domestic price for cathode copper was restricted to 68 cents per pound until removal of price controls at the end of April after which the price advanced in two steps to a record high of 85 cents per pound on June 1, then, reflecting changing market conditions, was reduced in four steps to a dual 68- and 72-cent-per-pound quotation at yearend.

Legislation and Government Programs.—Copper held in the national stockpile on January 1, 1974, included 60,112 tons of oxygen-free, high-conductivity (OFHC) copper, 7,067 tons of copper in beryllium-copper master alloys, and 191,480 tons of copper in "other" classifications, a total of 258,659 tons Public Law 93–214 signed into law on December 28, 1973, authorized the disposal of all of the stockpile copper except the relatively small quantity in the form of beryllium-copper master alloys. In accordance with this authorization the General Services Administration (GSA) transferred 85,000 tons to the Bureau of the Mint and announced sealed bid sale awards on February 20, April 2, and May 24 for approximately 45,300 tons, 60,000 tons, and 39,000 tons, respectively. The remaining quantity, approximately 22,400 tons, was made available for defense set-aside sales and all but 489 tons was disposed of by yearend.

The Office of Minerals Exploration continued to offer up to 50% government participation in the authorized cost of exploration for copper deposits. There were no contracts executed in 1974 that involved copper.

Defense set-asides for controlled copper materials were in effect for certain brass mill, wire mill, and foundry products. The controlled items and their percent set-asides were as follows: Unalloyed brass mill products—sheet (2), rod (9), and tube (2); alloyed brass mill products—sheet (4) and rod (10); copper wire mill products (2); and copper foundry products (3). In February a set-aside for refined copper produced from domestically mined ore was established at a level of 5% of shipments, using the fourth quarter of 1973 as the base period. A proposal to broaden the base for copper set-asides to include all copper materials except scrap, of both domestic and foreign origin, was published in the Federal Register in September. However, no further action was taken on the proposal.

The duty on unmanufactured copper remained at 0.8 cent per pound. However, duties were suspended by Public Law 93–77, effective from July 1, 1973 to June 30, 1974, and by Public Law 93–497, effective from July 1, 1974 to June 30, 1975.

DOMESTIC PRODUCTION

PRIMARY COPPER

Mine Production.—Domestic mine production of recoverable copper was 1.60 million tons, a 7% decline and the smallest quantity since 1971. Principal copper producing States were Arizona, with 54% of the total, Utah (14%), New Mexico, (12%), Montana (8%), Nevada (5%), and Michigan (4%). These States accounted for 97% of total production. Strikes at most producing units during portions of July and August adversely affected output. Also in response to reduced demand for copper several producers made announcements in November and December of decisions to curtail operations.

Open pit mines accounted for 81% of mine output and underground mines for 19%. The production of copper from dump and in-place leaching, mainly recovered by precipitation with iron, was 146,107 tons or 9% of mine output. Total copper recovered by leaching methods was 222,633 tons, of which 192,640 tons was precipitated with iron and 29,993 tons was electrowon.

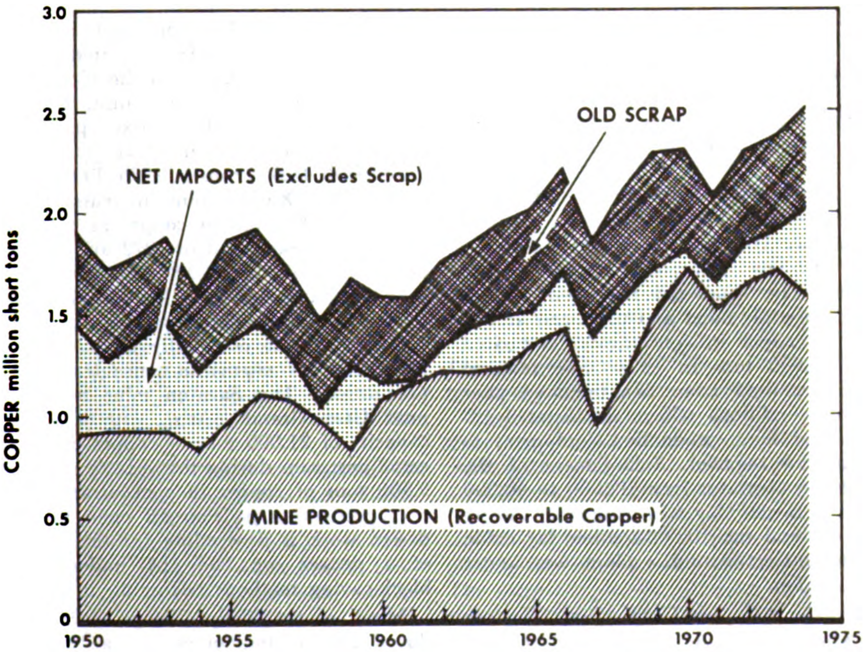

Figure 1.—Sources of copper supply for United States copper consumption.

Duval Corp., a subsidiary of Pennzoil Company, operated the Duval Sierrita open pit near Tuscon, Ariz., milling a record 30.9 million tons of ore averaging 0.29% copper and 0.026% molybdenum. Reserves at yearend were estimated at 554 million tons grading 0.32% copper and 0.033% molybdenum. Duval also operated the Esperanza and Mineral Park copper molybdenum open pit mines in Arizona and the Copper Canyon open pit copper mine in Nevada. These three operations milled 14.6 million tons of ore and also produced leach-precipitation copper from waste dumps. Total output from all operations was 121,080 tons of copper in concentrates and 11,500 tons of copper in precipitates.

The Anaconda Company produced 17,450 tons of copper from underground operations at Butte, Mont., compared with

21,670 tons in 1973. In September, the company announced its decision to phase out these underground operations because of the escalating cost of production and the declining price of copper. An extensive exploration program and feasibility study for large-volume, mechanized underground mining to ultimately produce copper from indicated vast quantities of deep, low-grade ore reserves has been started. In the interim an expansion of open pit operations is expected to largely offset the loss of underground production. The Berkeley pit produced 98,890 tons of copper compared with 104,470 tons in 1973 and the Continental-East pit, in its first full year of operation, produced 15,680 tons of copper. Production at the Yerington mine at Weed Heights, Nev., was 37,970 tons of copper. Work was near completion on the Victoria open pit copper mine and 1,000-ton-per-day concentrator near Ely, Nev. A major underground copper mine with an associated 10,000-ton-per-day concentrator, the Carr Fork project in the Bingham District of Utah, was under development with completion scheduled for 1979.

Anamax Mining Company, a joint venture of The Anaconda Company and AMAX, Inc., operated the Twin Buttes, Ariz., open pit mine and produced 40,140 tons of copper in concentrates compared with 73,650 tons in 1973. The reduced output resulted from unanticipated poor ground conditions which necessitated diversion of mine production equipment to overburden removal. Enlargement of the sulfide concentrator from 32,000 to 40,000 tons of ore per day was completed during the year and the 10,000-ton-per-day oxide ore leach-electrowinning plant was under construction.

Kennecott Copper Corp. operated mines in Arizona, Nevada, New Mexico, and Utah; these mines produced a combined total of 402,200 tons of copper, compared with 471,700 tons in 1973. The Utah Copper Div. accounted for 229,300 tons of the total followed by the Ray Mines Div. (Arizona) with 74,700 tons, the Chino Mines Div. (New Mexico) with 60,600 tons, and the Nevada Mines Div. with 37,600 tons. Severe weather conditions early in the year hampered production in Utah, output at the Nevada mine was reduced by temporarily lower ore grade, and all operations were disrupted by midyear strikes of 1 to 3 weeks' duration. New copper flotation equipment with higher copper recovery capability was installed at the Ray Mines Div. Kennecott also increased its capacity to treat copper silicate ore at Ray from 10,000 to 14,000 tons per day with an expansion of the copper ore leaching plant. Evaluation of a potential copper ore deposit beneath the perimeter of the Utah Copper Division's open pit continued. Plans include sinking a shaft, underground core drilling, and test mining to determine ground conditions and to obtain bulk samples for metallurgical testing. An environmental impact report was filed with the State of Wisconsin describing plans for developing an open pit copper mine near Ladysmith.

The American Smelting and Refining Company (ASARCO, Incorporated) operated three copper mines in the vicinity of Tucson, Ariz. The Mission unit, affected by a month-long labor strike, produced 40,300 tons of copper in concentrate compared with 46,600 tons in 1973. Production at the San Xavier mine increased from 2,700 to 5,900 tons of copper as the new leach plant completed in 1973 approached design capacity of 12,000 tons of copper in precipitates per year by yearend. The Silver Bell unit was unaffected by the strike and output was essentially unchanged at 23,500 tons of copper in concentrates and precipitates. The Sacaton mine and mill near Casa Grande, Ariz., with a design capacity of 21,000 tons of copper per year came onstream during the year to produce 9,500 tons of copper in concentrate. Current production is from an open pit but design work is proceeding for the mining of a deeper ore body by underground block-caving methods beginning in 1980.

Mines of the Phelps Dodge Corp. produced 281,338 tons of copper, a 12% decline from the 1973 record high. The decrease reflected strikes at the Arizona mines from July 15 to August 19, closure of open pit operations at Bisbee, and reduced work schedules. The Arizona mines at Morenci, Ajo, and Bisbee produced 112,790 tons, 43,501 tons, and 26,890 tons, respectively. Output at Tyrone, N. Mex., was 97,030 tons, and 1,127 tons was produced from miscellaneous sources. At Bisbee the Lavender pit was closed December 14 because of exhaustion of ore reserves, and continued operation of the underground mine was threatened by rising costs and declining copper prices. The $200 million Metcalf mine project near Morenci with a capacity to produce 60,000 tons per year of copper in concentrate was essentially completed by yearend. Underground development work continued at Safford, Ariz., to determine the feasibility of mining a deep ore body containing an estimated 400 million tons of ore with an average grade of 0.72% copper.

Cities Service Co., through its North American Chemicals and Metals Group, operated mines in Arizona and Tennessee that produced 30,600 tons of copper in concentrate compared with 39,600 tons in 1973. The Pinto Valley open pit mine and mill facilities near Miami, Ariz., were completed ahead of schedule and initial production began in June. Design capacity of 40,000 tons of ore per day or 60,000 tons of copper annually was expected to be achieved by early 1975. Development of the underground Miami-East mine continued and production from this relatively high-grade ore body is expected to begin in early 1976 and to reach a 2,000-ton-per-day level in 1978. In-place reserves of the Copper Cities and Diamond H mines near Miami will be exhausted early in 1975 but leaching operations at declining rates will continue for several years. A solvent extraction-electrowinning plant to replace the leach-precipitation plant was under construction with completion scheduled for mid-1976.

The White Pine, Mich., operations of White Pine Copper Co. milled 8.3 million tons of copper ore averaging 1.08% copper with an 85.7% recovery of copper in concentrate. As part of the cost reduction programs initiated in 1973, six new mobile rock-breaking devices known as feeder breakers were installed during 1974. These units enable efficient moveup of conveyor belts close to the mining faces which significantly reduces vehicle haulage and belt maintenance. Seven additional units are planned for 1975.

Magma Copper Co. operated the San Manuel and Superior underground copper mines in Arizona with a combined output of 149,600 tons of copper in concentrate compared with 158,300 tons in 1973. A 5-week strike during midyear and a cutback in operations near yearend curtailed production. Production at Superior continued to rise towards the 3,300-ton-of-ore-per-day rated capacity and during the fourth quarter averaged 3,000 tons. At the San Manuel mine two new hoisting shafts were completed to service production from deeper levels and to enable development of the adjacent down-faulted Kalamazoo section of the ore body.

The Inspiration Consolidated Copper Co. operated open pit copper mines in the vicinity of Inspiration, Ariz.; 18.5 million tons of waste and 8.5 million tons of ore were mined for a combined record high 27 million tons of material handled. Approximately 6.2 million tons of the ore was treated in the concentrator with about 47% of the concentrator feed first processed in leaching tanks to recover acid soluble copper. The combined production from in-plant processed ore in the form of concentrates, precipitates, and electrowon cathodes was 40,757 tons of copper. Heap-leaching of ore too low in copper content for in-plant treatment yielded an additional 8,943 tons of copper. Copper production from the Ox Hide mine was 4,840 tons from processing 3.4 million tons of ore. At the Christmas open pit mine, southeast of Miami, Ariz., output was 6,698 tons from processing 1.7 million tons of ore. The ratio of waste removed per ton of ore mined declined from 5.77 to 5.04. Total mine production from all operating mines was 61,238 tons of copper.

The Cyprus Pima Mining Co. operated the open pit Pima mine near Tucson, Ariz., milling 20 million tons of ore at a daily average rate of about 55,000 tons per day. Results of an extensive drilling program were being evaluated to determine if expansion of the present pit can be profitable. The expansion would require relocation of many existing support facilities and the old mill. Cyprus Bagdad Copper Co. at its Bagdad, Ariz., property produced about 12,000 tons of copper in concentrate from milling 2.17 million tons of sulfide ore averaging 0.74% copper. An additional 5,840 tons of copper was produced from oxide ore by a leach-electrowinning process. A major mine-mill expansion program designed to handle 40,000 tons of ore per day is planned to be completed by late 1977. Ore reserves at yearend were 300 million tons of proven ore averaging 0.49% copper, with additional tonnages indicated. The Cyprus Bruce Copper and Zinc Co. operated its underground copper-zinc mine near Bagdad, Ariz., and mined about 93,000 tons of ore grading 3.86% copper and 13.6% zinc. The Cyprus Johnson Copper Co. continued development of an oxide-copper ore deposit near Johnson, Ariz., with production scheduled for mid-1975 at a rate of 10,000 tons of ore per day. A leach-electrowinning process will recover about 5,000 tons of copper annually as cathodes. Reserves consist of 14.7 million tons of oxide ore with 0.80% total copper content which assures a life for the operation of about 10 years. An additional 10 million tons of mixed oxide and sulfide ore underlie the oxide deposit.

Ranchers Exploration & Development Corp. mined 4.5 million tons of ore and 4.7 million tons of waste to produce a record 7,487 tons of copper cathodes by a leaching-solvent extraction-electrowinning process at its Bluebird mine near Miami, Ariz. An expansion to increase capacity by 50% was planned for completion in 1976. Ore reserves were estimated to exceed 75 million tons. The *in situ* leaching operation at the Old Reliable deposit near San Manuel, Ariz., in the first full year of rated capacity operation, produced 2,688 tons of copper as a precipitate. At the Big Mike mine near Winnemucca, Nev., leaching operations yielded 580 tons of copper in precipitates compared with 971 tons in 1973.

Hecla Mining Co. in a joint venture with El Paso Natural Gas Co. continued mine development and plant construction at the Lakeshore copper mine south of Casa Grande, Ariz. The $185 million project is scheduled for production in the third quarter of 1975 with output to gradually build up to 65,000 tons of copper per year. Sulfide ore will be milled in a 9,000-ton-per-day concentrator with the concentrate treated by roasting, leaching, and electrowinning to produce 30,000 tons per year of cathode copper. The roasting operation will produce 200 tons per day of sulfuric acid for use in a 6,000-ton-per-day vat leaching plant to process oxide ore. The leach plant output will be 35,000 tons of copper in the form of precipitate copper.

UV Industries, Inc., operated its Continental mine near Bayard, N. Mex. Output was 24,167 tons of copper in concentrate from milling a record 1,701,000 tons of ore averaging 1.98% copper. Reserves at yearend were 16 million tons averaging 1.06% copper suitable for open pit mining and 7.5 million tons averaging 2.29 million tons suitable for underground mining.

Smelter Production.—Output of copper at primary smelters in the United States was 1.65 million tons, a 9% decrease from the record high of 1973 and the smallest quantity since 1971. The reduced production reflects disruptions by strikes at most smelters during portions of July and August.

ASARCO dedicated a 200-ton-per-day liquid sulfur dioxide plant at its Tacoma, Wash., smelter. This new plant plus the existing acid plant gives a capability to collect approximately 50% of the sulfur content of the copper concentrates processed by the smelters. At the Hayden, Ariz., smelter a 1,000-foot stack with connecting flues was completed in June. This stack in conjunction with an existing acid plant is expected to reduce sulfur concentrations to a level that will be in compliance with Federal ambient air quality standards. Also a highly sophisticated air monitoring and meteorological measurement system is in process of installation. At the El Paso, Tex., smelter a second acid plant is planned to collect sulfur emissions from both the copper smelter and the sinter machine of the lead smelter.

Anaconda completed installation of a baghouse and auxiliary equipment in a continuation of efforts to reduce emissions of particulates and sulfur dioxide gas to the atmosphere. An environmental monitoring system utilizing telemetry and computer components became operational during the year. A new fluid-bed roaster and electric furnace complex is under construction and when completed by the end of 1975 will permit greater recovery of sulfur gases and particulates. The four reverberatory furnaces now utilized will be maintained on a standby basis.

Kennecott completed construction of new converter hoods, duct work, an electrostatic precipitator, and an acid plant at its Hurley, N. Mex., smelter to improve control of smelter emissions. Production was adversely affected for a period of time during installation of the new equipment and adjustment to new operating procedures. At the McGill, Nev., smelter a 750-foot stack to improve dispersion of effluents and an air quality monitoring system was completed. Also engineering for a sulfuric acid plant was underway with construction scheduled to start in the second quarter of 1975. At the Hayden, Ariz., smelter throughput was reduced due to roaster and furnace equipment failures and problems associated with learning to operate new air pollution control facilities installed in 1973. At the Garfield, Utah, smelter a 1,200-foot stack, the tallest in the industry, was completed as part of an extensive construction project for improved environmental controls to be completed in 1977. Also included in the project will be the replacement of existing reverberatory furnaces and converters with a continuous smelting-converting unit developed by Noranda and also construction of an additional sulfuric acid plant.

Phelps Dodge made substantial progress in construction of a new copper smelter in Hidalgo County, N. Mex., with completion scheduled for third quarter of 1975. Cost of the smelter project, including townsite, is estimated at $200 million. It will be the first smelter in the United States to utilize the flash smelting process. Initially the facility will have the capacity to treat about 1,400 tons of concentrates daily, equivalent to about 100,000 tons of anode copper annually. All of these concentrates would be provided by the company's Tyrone mine. Tentative agreement was reached to smelt concentrates from the Cyprus Mines Corp. expanded Bagdad, Ariz., mine, beginning in 1978 which will require additional construction to increase the smelter capacity. At the Morenci, Ariz., smelter, a new reverberatory furnace, equipped with waste heat boilers and electrostatic precipitators to remove particulates from furnace gases, went into operation in August, but due to startup problems did not operate at capacity until later in the year. Smelter production was hampered throughout the year while hoods and flues were being installed at each of the nine converters. At the Ajo, Ariz., smelter, new emissions control facilities, including a 600-ton-per-day sulfuric acid plant, were completed.

Magma Copper Co. replaced a manually operated anode casting system with a computer-controlled anode casting system at the San Manuel smelter. The new system lowers costs by producing more closely controlled and uniform weight anodes which improves refining efficiencies and reduces the generation of anode scrap. A new sulfuric acid plant brought onstream in the fourth quarter, in conjunction with use of intermittent production controls at the smelter, when required by atmospheric conditions, will enable Magma to meet ambient air quality standards in effect. An auxiliary plant has been constructed to neutralize any acid produced in excess of sales.

Inspiration Consolidated Copper Co. completed a construction program which provided new production facilities including an electric furnace to replace the reverberatory furnace, new siphon-type converters, and a new sulfuric acid plant. Startup problems took much longer and presented more problems than expected. Repairs, necessitated by a leak which developed in one wall of the electric furnace, caused suspension of operations for 1 month. A strike caused a 40-day delay. By yearend, production at both the smelter and acid plant was improved but was still below rated capacity.

Refined Production.—Production of refined copper from primary materials decreased 11% to 1.65 million tons, the smaller quantity reflecting strikes at most producing units during portions of July and August. Refined copper produced from scrap was 496,908 tons compared with 465,123 tons in 1973. Total production of refined copper in the United States was 2.15 million tons, derived 77% from primary and 23% from scrap sources.

ASARCO continued construction on a new refinery of 420,000 tons of annual copper capacity at Amarillo, Tex. Some sections of the refinery will be brought into operation by mid-1975 and the entire facility is scheduled for completion during the first quarter of 1976. The Amarillo refinery will replace ASARCO's Baltimore refinery which will be phased out after 1975. Together with the necessary infrastructure and related facilities the project was estimated to cost on the order of $175 million and will employ 700 people. At the Tacoma, Wash., refinery of ASARCO a new plant was constructed to recover nickel salts from the copper electrolyte, replacing the existing plant built in 1917.

An expansion project by Anaconda to increase capacity at its Great Falls, Mont., refinery by 38% to 42 million pounds per month will be fully operational by March

1975. A modified power supply is incorporated in the expansion project which could provide an additional refining capacity increase of up to 3 million pounds per month.

Copper Sulfate.—Copper sulfate was produced from primary and/or secondary metal by companies with plants located as follows:

Company	Plant location
The Anaconda Company	Great Falls, Mont.
Chevron Chemical Co	Richmond, Calif.
Cities Service Co	Copperhill, Tenn.
Phelps Dodge Refining Corp	Laurel Hill, N.Y. El Paso, Tex.
Van Waters & Rogers Inc	Wallace, Idaho. Midvale, Utah.

Copper sulfate production declined 3% to 42,092 tons, a reversal of the upward trend of the past 2 years. Shipments plus consumption by producing companies exceeded production by 1,506 tons and ending stocks were drawndown to 3,074 tons, the lowest yearend level since 1959. Of the total 43,598 tons shipped, producers' reports indicated that 18,972 tons was for agricultural uses, 23,840 tons was for industrial uses, and 786 tons was for other uses.

Byproduct Sulfuric Acid.—Sulfuric acid was produced at 12 copper smelters from the sulfur contained in offgases, and output in 1974 increased for the seventh consecutive year from 1,088,300 in 1973 to a record 1,277,400 tons, on a 100% acid basis. Copper smelters at Ajo, Ariz., Hurley, N. Mex., Miami, Ariz., and San Manuel, Ariz. had initial production from new sulfuric acid plants in 1974. In addition, sulfuric acid plants were under construction at the McGill, Nev., smelter and at the new Hidalgo County, N. Mex., smelter. The indicated total capacity to produce acid at yearend was substantially greater than 1974 output.

SECONDARY COPPER AND BRASS

Domestic recovery of copper in all forms from all classes of purchased scrap totaled 1.34 million tons in 1974, a 2% decrease from the 1973 total. Recovery from copper-base scrap declined from 1.36 million to 1.32 million tons. Brass mills accounted for 42% of the recovered copper, primary producers for 32%, and secondary smelters for 21%. The remaining 5% was reclaimed at chemical plants, foundries, and manufacturers.

Consumption of purchased copper-base scrap in 1973 was 1.78 million tons consisting of 62% new scrap and 38% old scrap. Of the major categories of copper and copper-alloy products derived from scrap, the output of unalloyed copper increased 6% to 513,300 tons while production of brass mill products and brass and bronze ingots each decreased 8% to 702,700 tons and 261,600 tons, respectively.

CONSUMPTION

Consumption of refined copper was 2.19 million tons, a 10% decrease from the 1973 record high. The relatively high level of consumption in the first half of the year was substantially lower in the second half as a reflection of the slump in construction, automobile production, and other areas of the economy which consume copper. Wire mills accounted for 67% of refined copper consumption, brass mills for 31%, and all other categories for the remaining 2%.

Apparent withdrawals of primary refined copper on domestic account, excluding the supply component of approximately 252,000 tons released from the Government stockpiles, was 1.78 million tons compared with 1.90 million tons in 1973.

STOCKS

Stocks of refined copper at primary producers increased from 37,000 tons at the start of the year to 43,000 tons by the end of April, dipped to 24,000 tons at the end of June, then rose to 101,000 tons by yearend with much of the increase in November and December. This was the largest yearend stock level since 1970. Fabricators' stocks of copper in all forms increased from 419,000 to 496,000 tons during the year.

PRICES

The domestic producer price for refined copper was restricted to 68 cents per pound for cathodes until removal of price controls at the end of April after which the price advanced to 80 cents on May 1 and to 85 cents on June 1; then, reflecting changing market conditions, the price was reduced to 79 cents on September 17, to 75 cents on October 16, and to 72 cents on November 26. The cathode price was reduced to 68 cents by one producer, effective December 27, 1974, and by the other producers, effective January 3, 1975. Electrolytic wire bar quotations were 0.625 cent to 2 cents above quotations for cathode copper. Average quoted prices for electrolytic copper was 77.3 cents per pound for 1974 compared with 59.5 cents for 1973.

Prices on the London Metal Exchange (LME) escalated from a monthly average of 92.1 cents per pound for January to 137.5 cents for April with an alltime high daily quotation of 152 cents on April 1. After April there was a rapid descent of LME prices to an average 58.4 cents for December. The average for the year was 93.1 cents compared with 80.9 cents for 1973.

FOREIGN TRADE

Imports of copper were an increased component of supply in 1974 as imports of unmanufactured copper, excluding alloyed copper scrap, were 608,600 tons compared with 420,500 tons in 1973 while exports decreased from 277,600 to 198,100 tons. The largest trade category, refined copper, had a 55% increase in imports to 313,600 tons and a 33% decrease in exports to 126,500 tons. Imports of blister copper were 207,800 tons compared with 154,100 tons in 1973. The other import categories of ore, concentrates, matte, and unalloyed copper scrap totaled 87,200 tons and the other export categories of ore, concentrates, matte, blister, unalloyed scrap and ash and residues totaled 71,600 tons.

Exports of alloyed copper scrap, in gross weight, were 118,200 tons compared with 110,400 tons in 1973. Imports of alloyed copper scrap were 15,900 tons, gross weight, or 10,500 tons, copper content.

WORLD REVIEW

World mine production of copper attained 8.10 million tons in 1974, an increase of 3% with the most significant production increases coming from Chile, Poland, and Australia. The United States continued to lead the world in mine production with 20% of the total, followed by Chile 12%, Canada 11%, the U.S.S.R. 10%, Zambia 9%, Zaire 7%, Australia 3%, Philippines 3%, Peru 3%, and Poland 3%.

Stimulated by record high LME copper prices, the incentive for increasing mine production in the first half of 1974 was high. As the full impact of a worldwide economic recession hit the copper industry in the second half of the year, demand and metal prices dropped sharply. As producer stockpiles of copper began to buildup substantially by late 1974 a number of U.S. and Japanese copper companies began instituting mine and refinery production cutbacks of up to 20%. The Japanese copper industry, which was particularly hard hit by the economic downturn, was unable to market refined copper in the weakened Japanese domestic economy. The Japanese copper industry then began to negotiate with suppliers to reduce deliveries of ores and concentrates previously contracted for under long-term agreements and to resell substantial quantities of refined copper on the world market further depressing prices. In response to these events the Conseil Intergouvernemental des Pays Exportateurs de Cuivre (CIPEC), comprised of Chile, Peru, Zaire, and Zambia, met in Paris in November and agreed to cut all copper exports by 10% effective December 1, 1974.

World stocks of refined copper as reported by the World Bureau of Metal Statistics, were builtup from approximately 690,000 to 996,000 tons during the year. The stocks included producer, consumer, and merchant inventories of 245,000 tons of refined copper in the United States, 189,000 tons in Japan, and 192,000 tons combined between West Germany, France, and the United Kingdom plus 139,000 tons held in LME warehouses and 43,000 tons in Commodity Exchange Inc. (COMEX) warehouses in the U.S. The total world stock level represented the equivalent of 1.3 months of average demand of the world market economies for copper in 1974.

Argentina.—Cía. Minera Aguilar, S.A., the Argentina subsidiary of St. Joe Minerals Corp., continued development of a significant porphyry copper deposit with reserves currently estimated at 550 million tons of 0.65% copper and 0.015% molybdenum. Engineering studies, cost estimates, plans for smelter, mill and pit design, and studies of transportation access began or were completed in 1974. Development discussions with the Argentine Government were in progress with a proposed 1980 startup for a 75,000- to 100,000-ton-per-year copper operation being considered. The Pachon deposit is located in one of the most difficult access areas in the Andean range, 2 miles from the Chilean border. For most of the year the region is covered with 10- to 15-foot snow drifts.

Australia.—Mount Isa Mines, Ltd., operated its copper-lead-zinc-silver mine at Mount Isa and a copper smelter at Townsville to produce a record 168,000 tons of blister and 144,000 tons of refined copper for the fiscal year ending June 30, 1974. This output was the first year's achievement of the rated productive capacity of 170,000 tons resulting from an expansion program completed in 1973. The near capacity production was attained despite a cutback during February and March 1974 because of a 5-week closure of the flood-damaged Mount Isa to Townsville railroad which halted movement of supplies and concentrates. Reported reserves were 156 million tons of 3% copper.

Mount Lyell Mining and Railway Co., Ltd., a subsidiary of Consolidated Gold Fields Ltd., for the year ended June 30, 1974, produced 26,800 tons of copper in concentrate from 2.57 million tons of ore grading 1.19% copper mined and milled at its Tasmania operation. Surface ores accounted for 22% of total production during this period with the mining of the remaining surface ore in Crown Three open cut scheduled to be completed in late 1974. The transition towards full underground mining operations progressed smoothly during the year with the Prince Lyell section, the major underground ore body, accounting for 46% of total production. Reserves in all ore zones were estimated at 33 million tons of measured ore grading 1.47% copper and 11.7 million tons of indicated ore grading 1.40% copper.

The Woodlawn copper-zinc-lead-silver deposit near Tarrago, New South Wales, a 50/50 joint venture of Phelps Dodge Corp., and St. Joe Minerals Corp. (Jododex) was delayed by additional metallurgical pilot plant test work required by the refractory nature of the ore. Earlier feasibility studies are being updated on the basis of new pilot plant results and changing economic and political conditions in Australia. Ore grade material intersected during 1974 drilling gave considerable promise that underground mining may follow extraction of the originally announced open pit material.

Cobar Mines Pty., Ltd., fully owned by BH South Ltd., continued development of the significant massive sedimentary copper and copper-zinc deposits in central New South Wales. The mineralization occurs in lenses up to 3,300 feet wide in seven main ore bodies over a 10-mile strike length. The CSA mine, currently in production north of Cobar has estimated reserves of over 18 million tons grading 1.9% copper. In 1974 the two main shafts were deepened to 3,300 feet. The mill treated 727,500 tons of ore yielding 12,700 tons of copper contained in 50,860 tons of concentrates. An open stope and cut and fill stope mining method is in operation. During the year work was nearly completed on a 3,300-foot deep shaft south of the town of Cobar to give exploration and development access to the Chesney, New Occidental, Dapville, Gladstone, New Cobar, and Great Cobar ore bodies.

Kanmantoo Mines Ltd., in Kanmantoo, South Australia, also held by BH South Ltd., completed its second full year of production. Production for the fiscal year ending June 30, 1974, was 7,900 tons of copper contained in 35,600 tons of concentrate recovered from 1,041,100 tons of 0.82% copper sulfide ore milled. Drilling in 1974 disclosed ore bodies of similar grade and type as those at the open pit, which will be mined by underground methods when the open pit is mined out about 1982.

Construction of a plant to treat stockpiled oxide ores is expected to be completed by March 1975. Treatment of the stockpiled oxide ore, now in excess of 560,000 tons, will take approximately 3 years.

Peko-Wallsend Ltd., operated a copper-gold mine at Mount Morgan, Queensland, and the Tennant Creek copper-gold-bismuth mines in the northern territory. At the Tennant Creek operations the Warrego concentrator, rated at a capacity in excess of 770,000 tons per year, produced 16,300 tons of contained copper in 740,000 tons of ore treated. Ore reserves at the five Tennant Creek mines were over 8 million tons grading an average 3% copper. During the fiscal year ending July 9, 1974, Mount Morgan produced 10,600 tons of contained copper from 1.4 million tons of ore treated. Remaining reserves were estimated at less than 4 million tons grading 0.75% copper. The new smelter at Tennant Creek also came into full operation during the year. A pilot plant based on a process patented jointly by the University of Queensland and the company for the economic recovery of high-purity copper from leach liquors has been successfully operated at the Mount Morgan mine. The material treated was flue dust from the old smelting operations plus a test sample of current Tennant Creek flue dust. The process leaves a bismuth-copper residue in a form acceptable for direct smelting of the bismuth. In late December 1974 the company suspended all copper mining and smelting operations at Tennant Creek for economic reasons.

Discovery of a new copper deposit at Golden Grove, near Yalgoo in Western Australia, was reported by a consortium including AMAX, Inc., and the Electrolytic Zinc Co. of Australasia Ltd. The group has proven reserves to 1,800 feet of 11 million tons of 3.5% copper. An estimated $90 million investment is required to develop the planned mine, mill, and associated infrastructure.

Botswana.—Bamangwato Concessions, Ltd. (BCL), brought its Selebi-Pikwe nickel-copper mining and smelting project into production in December 1973 with initial mining of ore, and commissioned the surface treatment plant in February 1974. However, technical operating problems remained to be solved and the rated capacity of about 17,000 tons of copper and 19,000 tons of nickel in copper-nickel matte are not expected to be attained before early 1976. Ownership of BCL is 15% by the Government of Botswana and 85% by Botswana Roan Selection Trust, Ltd. (BRST), which in turn is owned 40% by the public and about 30% each by AMAX and the Anglo American Corp./Charter Consolidated Group.

Brazil.—In November 1974 the Brazilian Government nationalized copper production in Brazil with the takeover of the Caraiba deposit in the northeastern State of Bahía. Caraiba with an estimated 45 million tons of 1.3% copper ore is the most important copper reserve in Brazil. The mining and transportation operations of the former privately held Caraiba Metalis, S.A., will now be handled by the State-run Companhia Vale do Rio Doce (CVRD). Commercial and administrative operations will be run by Financiamentos de Insumos Basicos, S.A. (FIBASE), a subsidiary of the National Development Bank. New feasibility studies on developing an open pit operation and a smelter to produce 35,000 to 50,000 tons per year of contained copper from Caraiba are continuing.

Canada.—Mine production increased 2% in 1974 to a record high 928,550 tons of recoverable copper. Smelter output increased 8% to 591,990 tons and refinery production 12% to 616,329 tons of copper. Mine production increased in nearly all Provinces in 1974 except for British Columbia where production dropped 7% to 327,221 tons. British Columbia barely retained its position as the leading copper-producing Province with 35% of the total followed by Ontario with 34%, Quebec 17%, Manitoba 9%, and the remaining Provinces 5%.

In action which could have significant impact on future Canadian copper production and reserve levels, many companies are reported to have curtailed exploration activities and expansion programs in 1974 in British Columbia and to a lesser extent in Saskatchewan, Manitoba, and Ontario in reaction to increased taxes and royalties that have been set up by some Provinces. The new provincial taxes are in addition to Federal levies and created a double tax burden for the mining industry. A serious shortage of skilled mining and trades personnel also affected production levels at many Canadian copper operations during the year.

Falconbridge Nickel Mines Ltd. in 1974 produced copper from nine nickel-copper mines in Sudbury, Ontario, and Manibridge, Manitoba, and from five copper-zinc, copper, and iron-copper mines in Lake Dufault and Opemiska, Quebec, Sturgeon Lake, Ontario, and Tasu Harbor, British Columbia. Concentrates from the nickel-copper operations were processed at the company smelter in Sudbury and those from the other copper-zinc operations at the Noranda Mines Ltd. smelter at Noranda. Total metal deliveries in 1974 from all operations included 55,500 tons of copper, a decrease of 18% from those of 1973. Ore reserves at yearend at these two operations were 91 million tons averaging 1.4% nickel and 0.68% copper. The Lake Dufault Div. of Falconbridge Copper Ltd. milled 553,200 tons of 2.38% copper in 1974 to produce 12,230 tons of copper in concentrate, 35% less than in 1973. The decrease was attributed to a lower grade of ore treated. The Norbec mine was closed effective December 31, 1974, for economic reasons. Reserves at yearend were 2.5 million tons of ore grading 3.2% copper and 4.0% zinc. The Opemiska Division milled 927,000 tons of 1.85% copper in 1974 to produce 16,230 tons of copper in concentrate. The 25% cut in production was attributed to lower grade ore treated and to a shortage of skilled mine workers.

Plant construction at the new Cooke mine was completed and the shaft sinking reached 1,029 feet. Reserves at yearend were 6.4 million tons of 2.35% copper ore. The Sturgeon Lake Mines Ltd. open pit and concentrator came into production in September at a planned rate of 200 tons per day with 82,600 tons of ore grading 2.05% copper milled in the first 4 months of operation. Production of copper totaled 974 tons. Ore reserves at yearend were 2.2 million tons with an average grade of 2.80% copper, 10.19% zinc, 1.42% lead, 5.82 ounces of silver per ton and 0.021 ounce of gold per ton. In addition to the above, Falconbridge's Wesfrob mine, in Tasu Harbor, British Columbia, produced 2,300 tons of copper in concentrate in 1974 as a byproduct of the open pit iron operation.

Texasgulf Canada Ltd. (formerly Ecstall Mining Ltd.) mined 3.72 million tons of ore in 1974 up 3% over 1973 from the Kidd Creek mine near Timmins, Ontario. Production was about 74% from the open pit and 26% from underground. The mine yielded 231,700 tons of a 25% copper concentrate and 9,500 tons of a copper-silver concentrate during the year. The Kidd Creek zinc-silver-copper mine is one of the largest, mixed base metal mines in Canada having yielded from the start of operations in 1966 through the end of 1974 a total of 28.6 million tons of ore averaging 1.56% copper, 9.66% zinc, 4.3 ounces of silver per ton, and 0.38% lead. At the end of 1974 unmined reserves above the 2,800-foot level were estimated at 94 million tons of comparable grade ore. Exploration below 2,800 feet during the year indicated the ore body continues to at least 5,000 feet. Drilling indicated one 1,100-foot-long intersection assaying 3.2% copper with a true width of over 700 feet. The copper grade is increasing with depth and the zinc grade decreasing. Texasgulf is proceeding with plans to increase the mine production rate from 3.6 to 5.0 million tons per year. The expansion is scheduled to include a $200 million copper smelter and refinery complex with a capacity of 130,000 tons of copper per year. The Government-owned Canada Development Corp. acquired a 30% interest in Texasgulf Canada Ltd. during the year.

The International Nickel Co. of Canada Ltd. (INCO) mined 22 million tons of ore with an average grade of 1.39% nickel and 0.97% copper from 16 mines in Ontario and Manitoba in 1974 compared with 19.7 million tons of ore with an average grade of 1.41% nickel and 0.98% copper in 1973. Deliveries of copper metal from the Copper Cliff refinery increased 12% to 183,595 tons. At yearend INCO estimated that proven ore reserves in Canada were 414 million tons containing 1.62% nickel and 1.01% copper. In January production from the Crean mine was resumed on a regular basis. In December operations at the Clarabelle open pit mine in Sudbury ceased pending development of an extension to the mine. Development work on the Levack West underground mine also continued with a 4,000-ton-per-day mine production schedule expected to start in 1975.

Noranda Mines Ltd. had a full or partial interest in the treatment of 48.5 million tons of ore containing 226,300 tons of contained copper from 14 copper and zinc-copper mines in Quebec, British Columbia, Ontario, and New Brunswick. Shortages of skilled miners and tradesmen continued to hamper a number of Noranda's operations during the year. The company's two copper smelters at Noranda, Quebec, and Gaspé Copper in Murdochville, Quebec, in 1974 treated 938,000 tons of concentrates from Noranda operations and 929,300 tons of custom material from 29 other Canadian copper mines and from overseas. The 1.9 million tons of total material treated yielded 338,700 tons of copper contained in anodes, 10% more than in 1973. The Noranda smelter accounted for 79% and Gaspé 21% of anode production. Canadian Copper Refineries Ltd. (CCR) in Montreal East, Quebec, operated by Noranda, is one of the world's largest copper refineries with a rated annual capacity of 480,000 tons. In 1974 refinery production increased 11% to 427,000 tons of copper. CCR processes the output of the Noranda smelters, the Flin Flon smelter of Hudson Bay Mining & Smelting Co., Ltd. and from imported and some secondary sources.

Noranda's Horne Div. in Noranda, Quebec, produced 477,400 tons of ore averaging 2.57% copper and 0.147 ounce of gold per ton. The mill treated 390,000 tons of sulfide ore and 235,000 tons of smelter slags producing 71,500 and 57,300 tons of copper concentrates, respectively. Reserves of 400,000 tons of 1.74% copper at the Horne mine are expected to be depleted by 1976. Plans to bring the Magusi-New Insco ore bodies, with combined reserves of 3.2 million tons with an average grade of 3.1% copper, into production are underway. The Geco Div. in Manitouwadge, Ontario, produced 1.8 million tons of ore grading 1.72% copper, 4.72% zinc, and 1.56 ounces of silver per ton. Concentrates produced contained 29,200 tons of copper. Reserves at yearend were 28.6 million tons grading 1.87% copper, 3.69% zinc, and 1.59 ounces of silver per ton. The Bell Copper Div. in Granisle, British Columbia, mined 4.5 million tons of ore grading 0.52% copper in 1974. Concentrate output of 79,700 tons contained 20,800 tons of copper. Yearend reserves for the original pit design were over 34 million tons of 0.49% copper and 0.012 ounce of gold per ton at a waste to ore stripping ratio of 0.5 to 1. Studies indicate a future potential to expand reserves to 79 million tons at a 1.5 to 1 stripping ratio.

Gaspé Copper Mines (Noranda) produced 1.23 million tons of 1.09% copper ore and 43,500 tons of concentrate containing 11,530 tons of copper from the Needle Mountain mine and 9.32 million tons of 0.55% copper ore and 159,300 tons of concentrate containing 39,800 tons of copper from the Copper Mountain mine. Reserves at the two mines were, respectively, 23 million tons of 1.33% copper and 212 million tons of 0.38% sulfide copper plus 34 million tons of 0.45% oxide copper.

Brenda Mines Ltd. (50.9% Noranda) located in Peachland, British Columbia, operating one of the lowest grade porphyry copper mines in the world produced 9.55 million tons of ore averaging 0.186% copper and 0.051% molybdenum. In addition, the mining operation stockpiled 4.4 million tons of lower grade ore and removed 2.7 million tons of waste. Metal recoveries were 85.9% for copper in 51,365 tons of concentrates and 78.5% for molybdenum in 6,811 tons of leached concentrate. Yearend reserves were 127 million tons of 0.18% copper and 0.046% molybdenum.

Mattagami Lake Mines (43% Noranda) operated the Mattagami Lake mine in Quebec and the Mattabi mines in northwestern Ontario and began development work on a new underground mine at Lyon Lake in the Sturgeon Lake area of Ontario. Ore treated at Mattagami amounted to 1.4 million tons averaging 7.5% zinc, 0.62% copper, 0.88 ounce of silver per ton, and 0.017 ounce of gold per ton which yielded 27,150 tons of copper concentrate with a copper recovery of 76%. Remaining ore reserves totaled 12 million tons grading 8.7% zinc, 0.66% copper, 0.98 ounce of silver per ton, and 0.015 ounce of gold per ton. At Mattabi the concentrator treated 1.14 million tons of ore grading 0.91% copper yielding 8,600 tons of contained copper in concentrate. Ore reserves were over 11 million tons of 6.51% zinc, 0.74% copper, 0.64% lead, 2.42 ounces of silver per ton, and 0.007 ounce of gold per ton. Planning for the development and mining of the underground portion of the ore body is continuing. Reserves at the Lyon Lake deposit were an estimated 3.1 million tons of 6.2% zinc, 1.15% copper, 0.60% lead, 3.3 ounces of silver per ton, and 0.11 ounce of gold per ton.

Placer Development Ltd. (33% Noranda) operated the Craigmont mine in Merritt, British Columbia, and the Gibralter mine at McLeese Lake, British Columbia, during the year. The major porphyry copper open pit Gibralter mine milled 13.4 million tons of ore grading 0.40% copper. With a recovery rate of 84%, 45,123 tons of copper were produced in 166,800 tons of concentrate. Overall copper production decreased 26% due to the lower grade mined, a chronic shortage of qualified personnel to adequately maintain equipment and a 2-week wildcat strike in May. Mining in Stage 1 of the Gibralter east pit was completed in August when operations were transferred to the Granite Lake pit. In preparing the Granite Lake pit over 3 million cubic yards of overburden were removed and 850,000 cubic yards of silt were dredged from the lakebed. Overburden stripping commenced on the Pollyana ore zone and 658,000 cubic yards were removed by yearend. Reserves were estimated at 319 million tons at a 0.25% cutoff and an average grade of 0.36% copper. At Craigmont 1.52 million tons of ore grading 1.48% copper were milled. The 75,100 tons of concentrates produced contained 21,741 tons of copper for a metal recovery of 96.6%. Ore reserves of 8.6 million tons of 1.84% copper are sufficient to maintain operations at the 1974 level for 4 to 5 years.

Hudson Bay Mining & Smelting Co., Ltd. operated nine mines in the Flin Flon-Snow Lake area, Manitoba. Production at the Osborne Lake mine was interrupted by the considerable deeper level development work carried out during the year. Approximately 1.57 million tons of ore with an average grade of 2.4% copper were mined and milled to produce approximately 34,400 tons of copper in concentrates, a decrease of 16%. Development work on the access decline, underground services, and the 2,000-foot ore conveyor belt at the new Centennial mine were completed during the year with shaft-sinking scheduled to begin in January 1975. Construction of road, powerline, and surface mine buildings at the new Westarm mine were also completed with shaft-sinking scheduled to begin in April 1975. Total ore reserves at yearend were about 18 million tons grading 2.89% copper, 2.7% zinc, 0.0033 ounce of gold per ton, and 0.50 ounce of silver per ton. As a result of amendments to the British Columbia Mining Royalties Act, Hudson Bay and its partners Kennecott and Cominco Ltd. discontinued further exploration and development work on Stikine Copper Ltd.'s remote property in northwestern British Columbia. Stikine is reported as having impressive tonnage and grade for a porphyry-type copper deposit.

At Hudson Bay's Flin Flon copper smelter a new anode casting plant began operating in March to completely replace blister casting. The first of two new waste-heat boilers and a new stack to improve the handling of smelter waste gases became operational during the year. The smelter produced 54,418 tons of metal contained in blister and anode copper with 59% coming from Hudson Bay feed and 41% from purchased concentrates.

Lornex Mining Corp. Ltd. operated an open pit copper-molybdenum mine in the Highland Valley of British Columbia and produced 64,014 tons of copper and 2,017 tons of molybdenum in concentrate. The company delineated major additions to ore reserves at the Lornex property, which under normal economic conditions and reasonable tax and regulatory conditions would support an expansion of the operation.

Anaconda Britannia Mines, Ltd., discontinued operations at its mine in British Columbia, effective November 1, owing to a combination of limited ore reserves, rising costs, and reduced copper prices. The operation had been producing at an annual rate of approximately 6,000 tons of copper in concentrates.

The Caribou copper mine near Bathhurst, New Brunswick, a joint venture of The Anaconda Company and Cominco, suspended operations October 1 because of exhaustion of minable open pit copper ore. The Caribou mill had been rated at a capacity of 1,000 tons of ore per day to process the 3.4% average grade of ore mined.

Similkameen Mining Co. Ltd., a subsidiary of Newmont Mining Corp., operated its open pit mine near Princeton, British Columbia, and output for the year was 21,100 tons of copper in concentrate obtained from milling 5.1 million tons of 0.48% copper ore. Expansion of the concentrator was under construction to permit milling 7,000 tons per day of material grading about 0.25% copper which is now being mined and stockpiled. Ore reserves at yearend were estimated at 61 million tons averaging 0.53% copper.

Utah International, Inc. shipped approximately 45,500 tons of copper and 45,000 ounces of gold in concentrate from its Island Copper mine on the northern end of Vancouver Island in British Columbia. The mill output of copper was 6% lower than in 1973 and 21% below the design capacity of 57,500 tons of copper in concentrates annually. The lower production was due chiefly to a 7-week-long strike in August and September.

The Granduc mine of Granduc Operating Co., north of Stewart, British Columbia, produced 31,900 tons of copper in concentrate from 2.7 million tons of ore grading 1.23% copper. Re-examination of ore reserves in the light of production costs and anticipated copper prices resulted in a reduction of minable reserves from 33 million tons of 1.64% copper at yearend 1973 to 22 million tons of 1.71% copper at yearend 1974. Much of the eliminated reserves were of lower grade material in the undeveloped areas below the 2,100-foot level, which in turn is 500 feet below the haulage level.

Sheritt-Gordon Mines Ltd. operated the Fox, Lynn Lake, and Ruttan Lake mines in Manitoba with a combined output of 50,000 tons of copper in concentrates compared with 35,800 tons in 1973. The increase reflected the first full year of operation at the Ruttan Lake copper-zinc open pit operation in which 3.4 million tons of ore averaging 1.07% copper and 1.68% zinc were milled. At the Fox underground mine, 1.0 million tons of ore averaging 2.10% copper and 1.98% zinc were milled compared with 963,000 tons of 2.01% copper and 2.07% zinc in 1973. Output at the Lynn Lake nickel-copper mine was below expectations with ore milled declining to 432,000 tons assaying 0.87% nickel and 0.43% copper. Reserves at the Ruttan mine are estimated at 46 million tons of 1.45% copper and 1.52% zinc and at the Fox mine at 11 million tons averaging 1.95% copper and 2.07% zinc. At Lynn Lake reserves are adequate for about 5 years but high operating costs make continued operation uncertain.

Patino Mines (Quebec) Ltd., a subsidiary of the Dutch company Patino, N.V., operated or had an interest in five copper-gold mines in Quebec during 1974. Total mill production of 859,000 tons of 1.56% copper was down from the 1973 input of 973,000 tons of 1.62% copper. Metal production in 1974 amounted to 12,900 tons of copper in concentrate, down 16% from 1973. Two months of production were lost because of strike actions during the year. Ore reserves at yearend were 6.4 million tons of 1.74% copper and 0.046 ounce of gold per ton. The associated company Lemoine Mines Ltd. continued with the development of its new underground Bauzan mine located in a swamp 37 miles southeast of Chibougamau. The high-grade volcanogenic massive sulfide deposit contains reserves of 625,000 tons of 4.5% copper, 10.8% zinc, 2.7 ounces of silver per ton, and 0.138 ounce of gold per ton.

Bethlehem Copper Corp. Ltd. milled 6.3 million tons of ore grading 0.51% copper from open pit mines at Highland Valley, British Columbia, and produced concentrates containing 28,500 tons of copper compared with 33,500 tons in 1973. Exploration confirmed reserves of approximately 30 million tons of 0.45% copper in an extension to the closed Jersey pit and 15 million tons of 0.46% copper in the Iona ore body. Reserves at the operating Huestis pit are 14 million tons giving total reserves of 61 million tons of 0.47% copper available to the mill or enough for about 10 years of operation at the current rate. Development of the 286-million-ton J-A ore body and the adjoining 1-billion-ton 0.48% copper ore body of Valley Copper Mines Ltd., in which Bethlehem has a 20% interest, has been deferred due to adverse economic conditions and new taxing laws. Development of the Maggie ore zone, north of Highland Valley, with indicated reserves of 200 million tons of 0.40% copper, is also being delayed.

Union Minière Canada Ltd., initiated development of its Thierry copper deposit in the Pickle Lake, Ontario region with planned production for the second half of 1976 at an annual rate of 1.4 million tons of ore milled. The project is estimated to cost $85 million. Proven reserves amounted to 13 million tons averaging 1.73% copper, of which 3 million tons are amenable to open pit mining. Exploration work was in progress to further delineate reserves.

Chile.—In its first full year of control the new Chilean Government was instrumental in achieving a record copper production and encouraging a renewed foreign investment climate.

In a major first step, the Government promulgated Foreign Investment Law (DL-600) in July 1974. The new law guarantees foreign investors the right to repatriate the return of capital invested and profits obtained and that taxes as stated in the contracts will not be modified. In a second step Chile settled all litigation and outstanding claims for compensation for the expropriation of privately owned mines by the Allende Government in 1971. Cerro Corp. received an agreement for compensation of $41.9 million for its expropriated interests in Cía. Minera Andina, S.A. In July, Chile agreed to pay Anaconda $253 million, for its interests in the Chuquicamata mine. In October, Kennecott received a net compensation for the takeover of its interests in Sociedad Minera El Teniente, S.A., of $68 million.

In December, Chile reimbursed the U.S. Overseas Private Investment Corp. $18.6 million for insurance payments paid to Anaconda for its expropriated interests in the Exótica mine to conclude all outstanding obligations. In conjunction with these actions Chile began soliciting bids for new foreign investment participation in the further exploration and development of the country's copper resources which at yearend included eight known deposits with estimated combined ore reserves of 4 billion tons with a likely average grade of 0.8% copper. Cutoff date for bids on these deposits is March 30, 1975.

Production for the year increased 23% to 994,400 tons of copper and placed Chile as the world's second largest copper producer behind the United States. Production from the large mines was as follows: Chuquicamata, 393,200 tons compared with 292,400 tons in 1973; El Teniente, 248,500 tons compared with 196,300 tons; El Salvador, 88,200 tons compared with 92,600 tons; Andina, 75,400 tons compared with 61,800 tons; and Exótica, 35,500 tons compared with 35,100 tons.

In the medium and small mine production area, Mantos Blancos increased output 11% to 35,500 tons, Empresa Nacional de Minera (ENAMI) dropped 3% to 78,500 tons, and Disputada doubled production to a more normal level of 28,500 tons of copper.

New equipment expenditures of $28 million were made at the major mines, including the installation of a new reverberatory furnace at El Teniente to help compensate for abandonment of the oxygen converter process installed by Kennecott and the installation of a new pilot solvent extraction plant at Exótica.

Cyprus.—The Cyprus Island Div. of Cyprus Mines Corp. permanently closed its copper mining operations in July following a forced shutdown of operations resulting from Turkish military intervention. Prior to cessation of operations, 3,900 tons of copper in concentrates and precipitates were sold.

India.—Extensive exploration of India's copper resources indicated presently available ore reserves of over 335 million tons containing an average grade of 1.5% copper located in 25 deposits in 5 States. The Khetri copper project in Rajasthan, including a new flash smelter and electrolytic refinery, designed initially to produce 11,000 tons of copper annually began operation in November. Capacity of the project is expected to be increased to 50,000 tons by 1977. Feed for the smelter comes from two new mines, the Khetri (Madhan Kudhan) mine with reserves of 77 million tons of 1% copper and the Kolihan mine with 35 million tons of 2.5% copper.

With the cooperation of a Canadian technical assistance program a feasibility study was begun to assess the viability of developing the Rakha-Roam-Tamapahar deposit in the Singbhum Copper Belt of Bihar. Proven and inferred reserves are reported at 97 million tons of 1.3% copper.

Indonesia.—Freeport Indonesia, a subsidiary of Freeport Minerals Co. and operator of the 11,500-foot-high Gunung Bijih (formerly Ertsberg) copper mine in Irian Jaya, overcame difficult startup problems and reached planned production rate objectives in its second full year of operation. Production of copper for the year increased 73% to 72,100 tons of copper contained in 230,700 tons of concentrates. Copper content of ore mined continued to exceed the average 2.5% copper determined from original drilling. The contract with the Indonesian Government was modified in December discontinuing Freeport's tax holiday and making the company subject to a 30% income tax on operations beginning July 1, 1974, and increasing to 42% after 1983.

Elsewhere in Indonesia, Kennecott and Endeavor Oil Ltd. of Australia are continuing exploration work on a cluster of copper prospects near Gorantalo in the northern arm of the island of Sulawesi.

Iran.—Star Cheshmeh Copper Mining Co., an Iranian Government-owned company, had under development a copper mine and metallurgical complex in southern Iran. Work included stripping operations for the open pit and construction of foundations for the concentrator, smelter, and auxiliary buildings. Design capacity of the complex is approximately 160,000 tons of copper per year with initial production scheduled for mid-1977. Plans include future construction of a refinery to process the smelter output. Ore reserves upon which the project is based are estimated at 400 million tons averaging 1.12% copper. Also substantial reserves of somewhat lower grade ore are indicated to exist in the area.

Malaysia.—The Mamut Mines Development Co., a consortium of Japanese firms in a joint venture with the Sabah Government and other Malaysian interests, continued development of a copper deposit near Mamut, Sabah. Production is scheduled for mid-1975 at a rate of 15,000 tons per day of 0.7% copper ore for an output of 30,000 tons per year of copper in concentrate. The concentrates will be exported to Japan for smelting.

Mauritania.—Société Minière de Mauritanie (SOMIMA) formerly 33.5% owned by Charter Consolidated Ltd. was taken over by the Mauritanian State mining organization rather than have it closed for economic reasons caused by high fuel and transportation costs. In order to maintain local employment the Government will continue to operate the mine. It is felt that the development of the substantial reserves of sulfide ore below the current oxide operations would make the mine more economically viable.

Mexico.—The Mexican Government in an effort to step up the exploitation of the country's substantial copper reserves encouraged the increased equity participation of Mexican private and Government interests in a number of new developments during the year. The Government plan to increase annual copper production to over 300,000 tons by 1977 from the present rate of 90,000 tons would make Mexico a major world producer of copper. The Mexican Government also warned during the year that all mining concessions that are not worked within a reasonable period of time will be confiscated.

Industrial Minera Mexico, S.A. (formerly ASARCO Mexicana, S.A.), increased the output of blister copper 2% to 37,900 tons. In April, ASARCO completed the sale to Mexican investors of 15% of the stock of ASARCO Mexicana, S.A., thus reducing its equity to 34%.

Compãnía Cuprifera La Verde, S.A. (formerly Minas Del Otono, S.A.) was created in October to develop the La Verde copper deposit at Gabriel Zamora, Michoacan, 200 miles west of Mexico City. Lytton Minerals Ltd., a Hudson Bay subsidiary, holds a 48% interest in the new company with the balance shared equally between the Government, Comision de Fomento Minero, and the privately held Mexican company Sociedad de Fomento Industrial, S.A. de C.V. Ore reserves at La Verde are estimated at 81 million tons of 0.7% copper. A $101 million investment is planned to develop an open pit mine and a 16,500-ton-per-day milling operation by 1978 with a later expansion to 22,000 tons. The annual production of metal in concentrates is projected at 37,500 tons of copper, 14,000 ounces of gold, and 400,000 ounces of silver. Construction is scheduled to start around mid-1975.

Compañía Minera de Cananea operated the Cananea mine and smelter to produce 44,373 tons of copper compared with 45,412 tons in 1973. Production was hampered by labor problems and some mechanical breakdowns. An expansion program designed to achieve an output of 70,000 tons of copper in 1976 was also adversely affected by labor problems and delays in deliveries of materials.

The Government intervened to speed up the development of the Santa Rosa and Pilares copper deposits in the Nacozari region of the State of Sonora by forming a new company, Cobre de Sonora, S.A. de C.V. The joint venture will be 70% owned by the Mexican Government and Mexican nationals, including Minera Lampazos (51%), Comision de Fomento (13%), and the Banco Nacional de Mexico and others (6%), with 26.25% held by The Anaconda Company and 3.75% by Phelps Dodge. Cobre de Sonora planned to invest $128 million by 1976 to construct a 15,000-ton-per-day concentrator to treat the estimated 143 million tons of 0.83% copper and associated silver and molybdenum ore. An annual output of 37,000 tons of copper in concentrates is planned. Concentrates will be shipped to a smelter-refinery facility planned for the nearby La Caridad development.

Mexicana de Cobre, S.A., 44% owned by the Mexican Government, started development of the La Caridad porphyry copper pit mine in Sonora. The 66,000-ton-per-day mill will be followed by installation of a smelter and refinery with a planned capacity of 140,000 tons of copper per year by 1978. Investment costs are currently $550 million. Ore reserves are reported at 760 million tons of 0.76% copper and 0.16% molybdenum.

Pakistan.—The Government controlled Resource Development Corp. continued active exploration of the Saindak porphyry copper deposit in the Chagai District of Baluchistan in southwestern Pakistan. The deposit discovered earlier by a United Nations Development Program-Government exploration team contains ore reserves estimated at 275 million tons of 0.5% copper plus a significant molybdenum content.

Panama.—Canadian Javelin Ltd. received and accepted letters of intent from a group of six British, Canadian, and Japanese companies to form a consortium to finance and develop the Cerro Colorado copper concession. Final establishment of the consortium, however, is pending approval of the project by the Government of Panama, with whom negotiations on long-term exploitation contract terms are continuing. Plans called for an 88,000-ton-per-day production operation to be completed in 4 years at an estimated cost of $700 million. Results of the diamond drilling exploration program completed on the concession during the year established the existence of approximately 1 billion tons of proven reserves with an average grade of 0.6% copper.

Papua New Guinea.—Bougainville Copper Pty., Ltd., controlled 53.6% by Conzinc Riotinto of Australia Ltd. (CRA), 20% by the Government of Papua New Guinea (PNG), and 26.4% by the public, milled 33.2 million tons of ore grading 0.70% copper and 0.03 troy ounce of gold per ton. Recovery and concentrate grade improved, despite a slight fall in head grade, to 706,000 tons of 28.73% copper concentrate yielding 203,000 tons of contained copper. Estimated ore reserves in the Panguna ore body at the end of 1974 were approximately 959 million tons of ore averaging 0.47% copper and 0.016 troy ounce of gold per ton. Concentrates from Bougainville are shipped to Japan, West Germany, and Spain for processing. In December at the request of overstocked Japanese smelters, CRA agreed to reduce deliveries of concentrates to Japan by 15%.

Exercising its new powers of self-government prior to full independence from Australia in 1975, the PNG Government requested a renegotiation of the 1967 Bougainville Copper Agreement with CRA. The new agreement approved in December 1974 terminated the tax exempt period, the 20% tax exemption on mining income, and the accelerated depreciation provisions previously granted Bougainville Copper and was set up to give the PNG Government the "lion's share" (70%) of excess profits over and above a reasonable return upon funds placed by a foreign investor at risk in a project. Additional provisions included increased cooperation on environmental matters, increased liaison with Bougainville Provincial Government, the establishment of normal controls such as import duties and tarriffs by the PNG Government and no further exploration outside the mine area without Government approval.

Exploration work on the Ok Tedi deposit located in the Star Mountain region of northwest Papua near the Indonesian border was halted during the year as negotiation on the terms of development and investment between the exploration license holder Kennecott Copper Corp. and the PNG Government continued. The Mount Fubilan portion of the deposit is one of the geologically youngest (1.2 million years) porphyry copper deposits yet discovered. The deposit consists of a central orthoclase-rich intrusion which contains most of the disseminated copper mineralization, a number of closely associated peripheral mineralized skarn bodies with high copper grades in massive magnetite zones, and a massive sulfide body with moderate copper grades in pyrite and pyrrhotite zones. An oxidized capping up to 1,000 feet thick is developed over the deposit.[8]

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[8] Bamford, R. W. The Mount Fubilan (Ok Tedi) Porphyry Copper Deposit, Territory of Papua and New Guinea. Econ. Geol., v. 67, No. 8, 1972, pp. 1019–1033.

Preliminary drilling suggests an estimated reserve of 275 million tons of 0.6% to 0.9% copper. The remote location of the Ok Tedi deposit, however, requires establishment of additional ore reserves before development can be considered. Work also continued on the Frieda River porphyry copper prospect in southwestern New Guinea. The exploration license holder Mount Isa Mines, Ltd. signed an agreement with a consortium of four Japanese companies which will earn a 40% interest in the project by spending $5 million over the next 5 years on exploration, testing, and engineering work.

Peru.—Empresa Minera del Centro del Perú (Centromin), the State mining agency, operated six underground and one open pit copper-producing mines, including the former Cerro Corp. properties, expropriated January 1, 1974. Centromin also operated the smelter-refinery complex at La Oroya previously owned by Cerro. An expansion program is planned to increase both the existing smelter capacity of 58,000 tons and the refinery capacity of 39,000 tons to 73,000 tons by the end of 1978 which will be needed to take care of the expansion of the Cobriza mine and increases in purchased concentrates.

Empresa Minera del Perú (Minero Perú), the State mineral development agency, plans for a first-stage capacity of 36,000 tons per year of copper production from the Cerro Verde oxide copper deposit in southern Peru by use of heap-leaching methods. The underlying Santa Rosa sulfide ores are scheduled for initial mining in 1978 at an annual rate of about 120,000 tons of copper. Other mine developments scheduled for 1978 are the Tintaya deposit estimated to produce 70,000 tons of copper per year, the Ferrobamba/Chalcobamba property at 40,000 tons, the Berenguela property at 20,000 tons, and the Toro Mocho property at 90,000 tons. The following year it is planned to bring into production the Antamina property at 24,000 tons, Michiquillay at 80,000 tons, and Quellaveco at 100,000 tons. Minero Perú has a copper refinery under construction at the port town of Ilo in southern Peru. Initial capacity of 165,000 tons per year is scheduled for November 1975 and continuation of construction is planned to expand capacity to 330,000 tons over the following 3 years.

Southern Peru Copper Corp. (SPCC) operated the Toquepala open pit copper mine and the Ilo copper smelter with production of 134,400 tons of recoverable refined copper. Output was again curtailed by strikes with 49 days lost at the mine and 50 days lost at the smelter. A higher than average ore grade of 1.24% copper helped to mitigate the effects of the strikes on mine production.

Progress on SPCC's Cuajone project in 1974 included driving 4.3 miles of railroad tunnel to bring the total to 14.3 miles of the 17 miles required. Considerable progress was also made on the concentrator, housing, smelter, and powerplant expansion. Cuajone with a design capacity of 170,000 tons of blister copper is scheduled for completion in late 1976. Estimated cost of the project has increased since its start and at the end of 1974 was estimated to cost $620 million, including $70 million during construction.

Compañía Minera del Madrigal, a subsidiary of Homestake Mining Co., processed 197,000 tons of ore at its Madrigal copper-lead-zinc mine in southern Peru and shipped approximately 10,700 tons of copper concentrates to Japan. Ore grade averaged 1.8% copper, 2.8% lead, and 3.0% zinc. Operations remained below design capacity, largely because of unavailability and slow delivery of required equipment and supplies.

Philippines.—Continuing its development into a major world copper producer, the Philippines had 8 major porphyry copper mines producing 138,000 tons of ore daily, 8 other deposits expected to be in production within 3 years, and 18 additional major and promising prospects in the exploration stage. Total reserves of porphyry copper ore in the country were estimated at about 2.7 billion tons grading between 0.30% and 0.64% copper. Economic strains on the industry at yearend created by low copper prices and Japanese requests to cutback on copper shipments were balanced in part by the Philippine Government's decision to reduce the export tax on copper from 6% to 2%. Production by 14 mining companies was 248,600 tons of copper in concentrates and direct shipping grade ore, compared with 243,800 tons the previous year.

Atlas Consolidated Mining & Development Corp., one of the largest copper producers in Asia, increased production of copper contained in concentrates by nearly 7% in 1974 to 96,285 tons. The company operated the Frank open pit, the Lutopan underground mine and a 37,000-ton-per-day mill at the Lutopan ore deposit, and the Biga open pit and a 33,000-ton-per-day mill at the Biga deposit, both on Cebu Island, Central Philippines. Feasibility studies were completed and plans were announced to develop the new Carmen open pit located between the Frank and Biga pits and an associated 35,000-ton-per-day mill with production scheduled to start in late 1976. The Carmen ore body contains reported reserves of 294 million tons grading 0.44% copper. These reserves are in addition to the 769 million tons of 0.47% copper contained in the two operating properties. Atlas also announced plans to construct a new smelter, refinery, and acid plant complex by 1978. Capacity of the smelter will be 130,000 tons of copper.

Marcopper Mining Corp., a subsidiary of Placer Development Ltd., mined a high-grade (0.82%) copper ore zone during the year at its Santa Cruz, Marinduque operation and despite a 13% decrease in the ore milled to 6.45 million tons, production of copper in concentrate increased 13% to 51,670 tons. A total of 181,410 tons of concentrate was produced with a metal recovery of 88.5%. In addition 6,200 tons of leach concentrate was produced. A re-evaluation of ore reserves in 1974 downgraded estimated minable reserves at yearend to 102 million tons a 0.40% cutoff and a 0.58% average grade of copper.

Marinduque Mining and Industrial Corp. operated the Sipalay open pit in Negros Oriental and the Bagacay pit in Samar. At Sipalay completed expansion projects helped increase production for the year to 26,782 tons of contained copper with remaining reserves estimated at 377 million tons of 0.52% copper. Production at Bagacay amounted to 7,692 tons of contained copper with available reserves reported at 2.9 million tons of 1.56% milling grade copper ore and 214,000 tons of 12.72% shipping grade copper ore. An agreement in principle was reached in late 1974 between Marinduque, Lepanto Consolidated Mining Co., and a consortium of small copper producers to build a new copper smelter and refinery near Manila. Tentative plans call for a two-stage project with initial capacity at 88,000 tons per year of refined copper increasing later to 132,000 tons per year. The two major companies will provide financing with help from the Philippine Government.

Philex Mining Corp. increased production in 1974 to 28,894 tons of copper contained in concentrates. The company operated the Santo Tomas underground mine near Benguet, northern Luzon, with reserves of 133 million tons of ore grading 0.47% copper. Plans were announced to expand caving operations and increase mill capacity from 21,000 to 24,000 tons of ore per day by 1977.

Lepanto Consolidated Mining Co. operated one of the few nonporphyry copper mines in the country, a massive stratabound-volcanic underground ore deposit located in Mt. Province, northern Luzon. The decrease in production to 15,942 tons of copper contained in concentrates was directly related to difficulties in marketing concentrates with a high arsenic content. ASARCO, who normally handles the bulk of Lepanto concentrates had delayed a decision on a long-term smelting contract with Lepanto pending the impact of U.S. arsenic air pollution regulations on the future of its Tacoma, Wash., smelter. Reserves at the Lepanto mine were estimated at the beginning of the year at 9.4 million tons of 2.77% copper and 0.123 ounce of gold per ton. Lepanto also continued work on development of its Hinobaan deposit in Negros Occidental. Plans called for a $68 million investment to install a 20,000-ton-of-ore-per-day mine and mill operation to exploit reported reserves of 108 million tons of 0.5% copper.

Two new copper producers came on full stream during 1974, Apex Exploration and Mining Co., Inc., and Western Minolco Corp. Apex which began operation of the Masara project in Davao del Norte, Mindanao, in September 1973 produced 629 tons of contained copper in 1974. The Masara project includes mining of the new Kurayao and Wagasara open pits, the construction of a leach plant to reclaim the 2,300 tons of recoverable copper contained in the Sorina dump of the old Hope mine, the rehabilitation of the Masara mine workings, and the setting up of a 10,000-ton-of-ore-per-day mill at Wagas-Mapula. Reserves in the Kurayao area were reported at 4 million tons of 0.42% copper and at Wagas-Mapula at 31 million tons of 0.41% copper. Western Minolco began mining operation at its Boneng and Lobo ore bodies in Benguet, northern Luzon, in February 1974. Production of 21,920 tons of concentrates in 1974 contained 5,929 tons of copper. Plans were also announced to increase the initial mill capacity of 15,000 tons of ore per day to 30,000 tons of ore per day, equivalent to about 50,000 tons of contained copper annually by 1976. Combined ore reserves at Boneng-Lobo are estimated at 108 million tons of 0.48% copper.

Poland.—In 1974 production of copper increased 23% to 209,400 tons. Poland eventually plans to become one of the world's major copper exporters with annual production of around 400,000 tons. This program will require investments estimated at $1 billion with a substantial share expected to be obtained from interests in the United States.

Rhodesia, Southern.—M.T.D. (Mangula) Ltd. during the year ending September 30, 1974, produced 16,800 tons of copper in concentrate and precipitates from the Mangula mine about 80 miles northwest of Salisbury. Concentrates containing 14,600 tons of copper were produced from milling 1.4 million tons of sulfide ore and precipitates containing 1,200 tons of copper were produced from treating 270,000 tons of an oxidized ore in the leach plant. Leach plant operations were closed between December 1973 and July 1974 due to a shortage of sulfuric acid. Proven sulfide ore reserves were 16.5 million tons averaging 1.25% copper and oxidized ore reserves amounted to 0.5 million tons of 0.83% oxide copper. The Norah and Silverside mines produced 3,200 and 1,800 tons of copper in concentrates, respectively. Proven sulfide ore reserves were 2.1 million tons of 1.36% copper at the Norah mine and 640,000 tons of 1.75% copper at the Silverside mine.

Lomagundi Smelting and Mining Ltd. produced 2,300 tons of copper in concentrate from mining and milling 340,000 tons of ore from the Alaska mine. The Shackleton mine yielded 10,160 tons of copper in concentrate from 670,000 tons of 1.85% copper ore. Proved reserves at yearend were 1.0 million tons of 1.19% copper at the Alaska mine and 1.7 million tons of 2.14% copper at the Shackleton mine. The Gwai River mine produced 1,400 tons of copper in concentrate from mining and milling 195,000 tons of 0.79% copper ore. Proved ore reserves were 240,000 tons of 1.00% copper.

South Africa, Republic of.—O'okiep Copper Co. Ltd. mined and milled 3.2 million tons of ore with an average grade of 1.28% copper which yielded 35,800 tons of blister copper compared with 37,800 tons in 1973. Ore reserves at O'okiep mines at the end of 1974 were estimated at 29.1 million tons averaging 1.65% copper. Adverse market conditions in the latter half of the year caused suspension of development at the Spektakel and Divide nonproducing mines and development of deep ore zones at the Carolusberg mine. Also production from mines with low-grade ore was curtailed. O'okiep and the Tsumeb Corp. Ltd. (South-West Africa) began engineering work on a new 130,000-ton-per-year electrolytic copper refinery in the Capetown area to refine the smelter output of the two companies. However, the project has been deferred pending improvment of economic conditions.

Palabora Mining Co. Ltd. had a smelter production of 101,900 tons of copper, a 4% decline from 1973. Ore milled was 21.2 million tons of 0.56% copper compared with 21.2 million tons of 0.57% copper in 1973. A planned major expansion of the open pit mining and ore processing facilities was announced with completion expected early in 1977. Milling capacity will be increased from an average 58,000 to 82,000 tons of ore per day, equivalent to 138,000 tons of copper annually. The capacity of the electrolytic refinery will be increased to handle the entire copper output.

Messina (Transvaal) Development Co. mined and milled 1.2 million tons of 1.04% copper ore from its Messina mine which yielded 11,300 tons of copper in concentrate. The tonnage of proved ore reserves at yearend was estimated at 5.7 million tons averaging 1.45% copper.

Phelps Dodge Corp. carried out pilot plant testing of bulk ore samples from the most promising of two copper-lead-zinc-silver discoveries in the vicinity of Aggeneys in Cape Province. Proven reserves in the open pit portion of this ore body were estimated at 79 million tons averaging 0.38% copper, 4.28% lead, 2.32% zinc, and 1.7

ounces of silver per ton. Arrangements were in progress to obtain power and water for planned mining operations.

South-West Africa, Territory of.—The Tsumeb Corp. Ltd. mined 464,000 tons of ore from the Tsumeb mine averaging 4.36% copper, 10.06% lead, and 2.30% zinc. At the Kombat mine 389,000 tons of ore grading 1.19% copper and 2.62% lead was mined. The Matchless mine, near Windhoek, reopened in 1973, produced 119,000 tons of ore averaging 1.93% copper in 1974. Smelter production at Tsumeb was 51,400 tons of blister compared with 39,700 tons in 1973. The smelter is being expanded to an annual capacity of 79,000 tons which will enable custom smelting of concentrates from other mines in South-West Africa. Ore reserves as of the end of 1974 were estimated at 6.1 million tons assaying 4.56% copper, 7.79% lead, and 2.06% zinc for the Tsumeb mine; 1.2 million tons of 1.91% copper and 3.32% lead for the Kombat mine; and 1.3 million tons of 2.28% copper at the Matchless mine.

Oamites Mining Co. (Pty.) Ltd. (75% Falconbridge) milled 680,000 tons of ore grading 1.13% copper. Metal recovery in 21,000 tons of concentrate was 91.32% yielding 7,000 pounds of copper. Ore grade was down from 1.35% in 1973 due to decreasing and proportionately diluted vein width towards the limits of the ore body.

Spain.—Rio Tinto-Patiño, S.A. (RTP), operated the Cerro Colorado open pit mine and a custom smelter and refinery in the southern province of Huelva in 1974. RTP treated over 3 million tons of copper ore, a decrease of 8% from 1973. Copper output was 23,900 tons. Ore reserves include 61 million tons of 0.71% copper at Cerro Colorado and 20 million tons of 0.69% copper at Santiago. The Santiago open pit copper deposit in the northwestern province of Galicia is scheduled to start operations in the second quarter of 1975 at a mining rate of 4,400 tons daily. The RTP smelter produced 52,800 tons of anode copper from primary concentrate and cement copper feed and 49,900 tons from secondary sources. Planned startup of a new flash smelter and a second acid plant in 1975 will double the rated smelter capacity to 93,000 tons of copper. The electrolytic refinery which produced 80,800 tons of cathode copper for the year is scheduled to expand its capacity to 116,000 tons in 1975.

Uganda.—Kilembe Mines Ltd. (73% Falconbridge) reportedly encountered difficulty in maintaining operations on an economic basis during the year due to a combination of local supply shortages, lack of trained personnel, difficulties in moving imported goods from port to the mine, and lower copper prices. Negotiations with the Uganda Government were in progress to attempt to resolve the difficulties. Production of milled ore decreased 14% to 780,200 tons and blister copper 8% to 9,800 tons.

Yugoslavia.—Estimated primary production of copper by Rudarsko Topionicarski Bazen (RTB), Bor, Serbia, in 1974 included 136,000 tons of copper in concentrate, 180,000 tons of blister copper and 154,000 tons of refined copper. In addition to domestic material the smelter handled 38,600 tons of imported ore and concentrates, chiefly from Chile. RTB operated a mine, flotation plant, and smelter at Bor, and a mine and flotation plant at Majdanpek. Development work continued on a large deposit of low-grade ore at Krivelj with plans for an annual capacity of 66,000 tons of copper to be reached by 1981. Work also continued on the development of the second major copper-producing facility in Yugoslavia at Bucim, near Radoviste, Macedonia. Work on a mine and beneficiation plant at the Bucim copper deposit were started during the year with a two-phase project scheduled to reach an annual capacity of 23,000 tons of copper by 1977 with a later expansion to 66,000 tons.

Zaire.—In major actions affecting copper production the Government of Zaire announced its firm determination to have the country's entire copper production refined domestically by 1980. By that year expansions announced under the Second 5-Year Plan combined with the two private/Government joint venture developments currently underway are scheduled to increase Zaire's annual copper production to 880,000 tons. The Government also reached an agreement in principle to compensate the Belgian company. Union Minière du Haut Katanga, with a sum of $100 million for the 1967 expropriation of its mines now run by the State agency La Générale des Carrières et Mines du Zaire (Gécamines).

Copper production in Zaire increased

2% to 549,900 tons. Gécamines which operates 10 mines, 5 mills, 2 copper smelters at Lubumbashi and Panda and 2 copper-cobalt refineries at Shituru and Luilu in Shaba Province produced 519,100 tons of copper including 357,000 tons of copper in refined shapes. Plans to increase annual production of copper to 628,000 tons by 1978 include the development of two new open pit mines, Dikuluwe and Mashambe, a new mill with an annual capacity of 4 million tons of ore, a flash smelter and an electrolytic refinery all near Kolwezi, Shaba. The two new mines with combined reserves estimated at 171 million tons of 4.1% copper and 0.3% cobalt are due to open in late 1975.

The joint Zairian Government-private Japanese concern, Société de Dévelopment Industriel et Minière du Zaire (SODIMIZA), in its second full year of operating the Mushoshi mine and mill in Shaba Province increased mine production 10% to 1.5 million tons of ore in 1974. Production of 85,000 tons of concentrate with an average copper content of 36% yielded 30,500 tons of contained copper. SODIMIZA continued development of the Kinsenda mine during the year seeking the most suitable mine design to exploit an irregular-shaped ore body and to control serious ground water problems. Production is not expected to begin before 1977 or 1978. Previous estimates placed ore reserves at Mushoshi at 110 million tons of 3.5% copper with 35 million tons of 5.5% copper at Kinsenda.

Société Minière de Tenke-Fungurume (SMTF), a consortium of American, British, French, and Japanese companies and the Government of Zaire, continued construction and development of the Tenke-Fungurume project during the year. The scheduled startup date for the planned 165,000-ton-capacity refinery may be delayed past 1977 pending the completion of installation of the new Inga Dam to Shaba electric power transmission lines. Inflation has raised the cost of the SMTF project to over $700 million. Reserves of mixed oxide and sulfide ore were estimated at 52 million tons of 5.4% copper and 0.42% cobalt. SMTF plans to use a process involving the conversion of sulfides to oxides prior to recovery of copper by leaching, solvent extraction, and electrowinning.

Zambia.—Transport problems resulting from the 1973 border closure with Southern Rhodesia continued and the alternate road routes to Dar es Salaam, Tanzania, and Mombasa, Kenya, and the rail route to Lobito, Angola, were utilized for shipment of copper. Completion of the Tanzania-Zambia Railway (Tazara), scheduled for mid-1975, will improve transportation although congestion at the terminal port of Dar es Salaam could continue to be a problem.

Roan Consolidated Mines, Ltd. (RCM), operated the Mufulira, Chibuluma, Chambishi, Kalengwa, and Luanshya mines that produced 321,000 tons of copper for the year ended June 30, 1974, compared with 305,000 tons in 1973. Increased recovery at the Mufulira mine reflected continued recovery from the 1970 cave-in and flooding accident. At Luanshya there was greater output from the Baluba section and at Chambishi both ore mined and the copper grade increased. Production from Chibuluma was adversely affected by a decline in grade of ore mined.

Development of Kalulushi East, south of Chibuluma, continued. Ore reserves were estimated at 4.2 million tons averaging 4.15% copper. Initial production is scheduled for 1979 and will attain full production in 1981 to compensate for the phasing out of ore supply from the two shafts at Chibuluma during the same time.

Nchanga Consolidated Copper Mines Ltd. (NCCM), through the Rokana, Chingola, and Konkola Divisions, operated copper mines, a smelter, and a refinery. Mine production was 451,000 tons of copper for the year ended March 31, 1974, compared with 485,000 tons for the preceding year. The decline in output was largely associated with disruptions caused by an expansion program designed to achieve an annual rate of 550,000 tons by mid-1975. At the Konkola concentrator the high-grade leach plant produced a record 123,000 tons of copper, but delays due to shortage of construction materials affected production at the low-grade leach plant. Initial output of the solvent extraction-ion exchange process plant began in December 1973 and was fully operational in mid-1974. A decision was made to proceed with reopening of the Kasanshi mine located near Solwezi in the Northwestern Province that was closed by flooding in 1957. Operations will consist of an open pit mine and a leach-solvent extraction-electrowinning plant with a rated annual capacity of 28,000 tons of copper. Initial production is scheduled for late 1977.

Geomin, a Romanian-based mineral development company, in a joint venture with Mindeco Ltd., formed a new company, Mikambo Development Co., Ltd., to investigate the feasibility of beginning operations at Mikambo, near the Zairian border. The mine is believed to contain sufficient reserves to produce 16,000 tons of copper in concentrate annually for about 12 years.

TECHNOLOGY

Results of research[3] on mineralization relationships for seven low-grade and subeconomic porphyry copper deposits in western Canada may be usefully applied to the search for additional deposits. Findings included identification of normal outward zoning patterns from biotite-chalcopyrite to chlorite-carbonate-pyrite. Deep brown, coarse-grained, sugary-textured hydrothermal biotites are associated with relatively strong copper mineralization, whereas greenish and/or fine grained hydrothermal biotites are indicative of weak copper mineralization.

An open pit model and two underground models were developed to generate information on various aspects of mining the copper-nickel resources associated with the Duluth Gabbro Complex in northeastern Minnesota.[4]

To better understand those factors which increase mining costs in Alaska, a study was conducted to compare the estimated costs of producing copper from similar hypothetical porphyry deposits in Alaska and Arizona.[5] An evaluation of truck haulage costs included factors of capital costs, operating costs, reliability of operation, and indirect costs.[6]

A metal detection device using high-frequency alternating current was used in tests to determine applicability in upgrading native copper ores.[7] Research on recovering copper from mill tailings at 11 operations indicated recoveries from 15% to 65% with concentrate grades from 2% to 13% copper.[8] A report[9] summarizes procedures and costs for stabilizing mill tailings by chemical, vegetative, and combination procedures.

Several publications[10] described research conducted on recovering copper from chalcopyrite by application of hydrometallurgical methods. Results of batch tests on the cementation of copper on iron at elevated temperatures showed sufficient promise to justify development of a continuous-flow copper recovery process.[11] The continuous-flow tests produced copper in powder form exceeding 99.8% purity with a reaction rate more than 100 times that of conventional launder systems and with about a 0.9 ratio of iron consumption to copper production.

Experiments conducted to identify controlling parameters in loss of copper in smelter slags concluded that reduction of sulfur solubility by means of slag composition was a key factor.[12] Full-scale autogenous smelting tests on copper concentrate using a top-blown rotary converter (TBRC) successfully demonstrated the applicability of this process to produce blister copper.[13] Advantages of the TBRC process include relatively low capital and maintenance costs, low overall energy requirements, and up to 50% SO_2 concentrations in exhaust gases, facilitating economic recovery of sulfur.

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[3] Carson, D. J. T., and J. L. Jambor. Porphyry Copper Deposits. Mineralogy, Zonal Relationships and Economic Significance of Hydrothermal Alteration at Porphyry Copper Deposits, Babine Lake Area, British Columbia. Can. Min. and Met. Bull., v. 67, No. 742, February 1974, pp. 110–133.

[4] Hays, R. M. Environmental, Economic, and Social Impacts of Mining Copper-Nickel in Northeastern Minnesota. BuMines OFR 1–75, August 1974, 118 pp.

[5] Bottge, R. G. Comparative Porphyry Copper Mining and Processing Costs—Alaska and Arizona. BuMines IC 8656, 1974, 55 pp.

[6] Martin, M. D. An Economic Comparison of Haulage Trucks in the 100–250 Ton Range. Min. Cong. J., v. 59, No. 11, November 1973, pp. 22–26.

[7] Miller, V. R., R. W. Nash, and A. E. Schwaneke. Detecting and Sorting Disseminated Native Copper Ores. BuMines RI 7904, 1974, 14 pp.

[8] White, J. C., A. J. Fergus, and T. N. Goff. Recovering Copper From Mill Tailings. Selected Studies. BuMines RI 7868, 1974, 21 pp.

[9] Dean, K. C., R. Havens, and M. W. Glantz. Methods and Costs for Stabilizing Fine-Sized Mineral Wastes. BuMines RI 7896, 1974, 26 pp.

[10] Baur, J. P., H. L. Gibbs, and M. E. Wadsworth. Initial-Stage Sulfuric Acid Leaching Kinetics of Chalcopyrite Using Radiochemical Techniques. BuMines RI 7823, 1974, 38 pp.

Hundley, G. L., R. S. Olsen, and T. T. Campbell. Oxidation of Mixed Iron and Copper Chlorides. BuMines RI 7970, 1974, 16 pp.

Shirts, M. B., J. K. Winter, P. A. Bloom, and G. M. Potter. Aqueous Reduction of Chalcopyrite Concentrate With Metals. BuMines RI 7953, 1974, 18 pp.

Shirts, M. B., P. A. Bloom, and W. A. McKinney. Double Roast-Leach-Electrowinning Process for Chalcopyrite Concentrates. BuMines RI 7996, 1975, 33 pp.

[11] Reid, J. G., and A. K. Biswas. Continuous-Flow Production of Pure Copper by High-Temperature Cementation on Iron. Inst. Min. and Met. Trans., v. 82, No. 805, December 1973, pp. C221–C224.

[12] Nagamori, M. Metal Loss to Slag: Part I. Sulfidic and Oxidic Dissolution of Copper in Fayalite Slag from Low Grade Matte. Met. Trans., v. 5, No. 3, March 1974, pp. 531–538.

———. Metal Loss to Slag: Part II. Oxidic Dissolution of Nickel in Fayalite Slag and Thermodynamics of Continuous Converting of Nickel-Copper Matte. Met. Trans., v. 5, No. 3, March 1974, pp. 539–548.

Problems associated with alternative solutions to implement regulations for control of sulfur emissions at copper smelters are discussed in an article.[14] Another publication [15] estimated the comparative costs of five smelting procedures with SO_2 removal from stack gases ranging from 0% to 99%. Research developed a pyrometallurgical process to recover 98% of the zinc and 12% to 25% of the lead from brass smelter dusts.[16]

Laboratory investigations indicated that X-ray methods are capable of separating standard copper-base alloys into 10 general classes. These methods have a possible application for scrap metal recovery systems.[17]

Research using electron diffraction pattern techniques investigated changes in the crystal lattice pattern during aging for certain copper-titanium alloys.[18]

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[13] Daniele, R. A., and L. H. Laquay. Full Scale TBRC Smelting Tests on Copper Concentrate. Pres. at 1974 ann. meeting, AIME, Dallas, Tex., Feb. 24–28, 1974.

[14] Henderson, J. M. Environmental Overkill—The Natural Resource Impact. Min. Cong. J., v. 60, No. 12, December 1974, pp. 18–23.

[15] Hayashi, M., H. Dolezal, and J. H. Bilbrey, Jr. Cost of Producing Copper From Chalcopyrite Concentrate as Related to SO_2 Emission Abatement—An Evaluation of Five Smelting Procedures. BuMines RI 7957, 1974, 87 pp.

[16] Fukubayashi, H. H., and L. W. Higley. Recovery of Zinc and Lead from Brass Smelter Dust. BuMines RI 7880, 1974, 10 pp.

[17] Marr, H. E., III. Rapid Identification of Copper-Base Alloys by Energy Dispersion X-Ray Analysis. BuMines RI 7878, 1974, 15 pp.

[18] Laughlin, D. E., and J. W. Cahn. Ordering in Copper-Titanium Alloys. Met. Trans., v. 5, No. 4, April 1974, pp. 972–974.

Table 2.—Copper produced from domestic ores, by source

(Thousand short tons)

Year	Mine	Smelter	Refinery
1970	1,720	1,605	1,521
1971	1,522	1,471	1,411
1972	1,665	1,649	1,680
1973	1,718	1,705	1,698
1974	1,597	1,532	1,421

Table 3.—Copper ore and recoverable copper produced, by mining method

(Percent)

Year	Open pit		Underground	
	Ore	Copper[1]	Ore	Copper[2]
1970	89	84	11	16
1971	88	82	12	18
1972	85	80	15	20
1973	89	78	11	22
1974	89	81	11	19

[1] Includes copper from dump leaching.
[2] Includes copper from in-place leaching.

Table 4.—Mine production of recoverable copper in the United States, by month

(Short tons)

Month	1973	1974
January	136,641	135,170
February	135,050	131,063
March	151,336	144,461
April	149,893	143,290
May	151,598	150,399
June	146,998	142,163
July	129,706	99,435
August	141,785	102,124
September	139,878	132,438
October	153,299	145,366
November	140,844	135,934
December	140,912	135,159
Total	1,717,940	1,597,002

Table 5.—Mine production of recoverable copper in the United States, by State

(Short tons)

State	1970	1971	1972	1973	1974
Arizona	917,918	820,171	908,612	927,271	858,783
California	2,308	515	598	369	194
Colorado	3,749	3,938	3,944	3,123	3,012
Idaho	3,612	3,776	2,942	3,625	2,841
Maine	2,703	2,510	1,220	1,107	1,522
Michigan	67,543	56,005	67,260	72,221	67,012
Missouri	12,134	8,445	11,509	10,273	12,665
Montana	120,412	88,581	123,110	132,466	131,131
Nevada	106,688	96,928	101,119	93,702	84,101
New Mexico	166,278	157,419	168,034	204,742	196,585
Pennsylvania	2,539	3,349	2,611	1,845	--
Tennessee	15,535	13,916	11,310	8,500	6,304
Utah	295,738	263,451	259,507	256,589	230,593
Other States[1]	2,500	3,179	3,064	2,107	2,259
Total	1,719,657	1,522,183	1,664,840	1,717,940	1,597,002

[1] Includes Oklahoma, Oregon, and Washington.

Table 6.—Twenty-five leading copper-producing mines in the United States in 1974, in order of output

Rank	Mine	County and State	Operator	Source of copper
1	Utah Copper	Salt Lake, Utah	Kennecott Copper Corp	Copper ore, copper precipitates.
2	San Manuel	Pinal, Ariz	Magma Copper Co	Copper ore.
3	Morenci	Greenlee, Ariz	Phelps Dodge Corp	Copper ore, copper precipitates.
4	Tyrone	Grant, N. Mex	do	Do.
5	Berkeley Pit	Silver Bow, Mont	The Anaconda Company	Do.
6	Ray Pit	Pinal, Ariz	Kennecott Copper Corp	Do.
7	Pima	Pima, Ariz	Pima Mining Co	Copper ore.
8	Sierrita	do	Duval Sierrita Corp	Do.
9	Chino	Grant, N. Mex	Kennecott Copper Corp	Copper ore, copper precipitates.
10	White Pine	Ontonagon, Mich	White Pine Copper Co	Copper ore.
11	Inspiration	Gila, Ariz	Inspiration Consolidated Copper Co.	Copper ore, copper precipitates.
12	Twin Buttes	Pima, Ariz	Anamax Mining Co	Copper ore.
13	New Cornelia	do	Phelps Dodge Corp	Copper ore, gold ore.
14	Mission	do	American Smelting and Refining Company.	Copper ore.
15	Yerington	Lyon, Nev	The Anaconda Company	Do.
16	Ruth Pit	White Pine, Nev	Kennecott Copper Corp	Do.
17	Magma	Pinal, Ariz	Magma Copper Co	Do.
18	Continental	Grant, N. Mex	UV Industries, Inc	Do.
19	Silver Bell	Pima, Ariz	American Smelting and Refining Company.	Copper ore, copper precipitates.
20	Butte Hill	Silver Bow, Mont	The Anaconda Company	Do.
21	Mineral Park	Mohave, Ariz	Duval Corp	Do.
22	Esperanza	Pima, Ariz	do	Do.
23	Bagdad	Yavapai, Ariz	Cyprus Bagdad Copper Co.	Copper ore.
24	Copper Cities	Gila, Ariz	Cities Service Co	Copper ore, copper precipitates.
25	Continental Pit	Silver Bow, Mont	The Anaconda Company	Copper ore.

Table 7.—Mine production of recoverable copper in 1974, by method of treatment

Method of treatment	Ore treated (thousand short tons)	Recoverable copper: Thousand pounds	Recoverable copper: Percent yield	Remarks
Copper ore:				
By concentration	269,016	2,692,182	0.50	See table 9.
By smelting	305	7,700	1.26	See table 10.
By leaching	24,122	[1] 153,051	.32	See table 11.
Total	293,443	2,852,933	.49	
Dump and in-place leaching	--	292,215	--	See table 11.
Miscellaneous from cleanup, tailings, and noncopper ores	--	48,856	--	--
Total	XX	3,194,004	XX	--

XX Not applicable.

[1] Includes 59,986,983 pounds of electrowon copper.

Table 8.—Copper ore shipped directly to smelters or concentrated in the United States, by State in 1974, with copper, gold, and silver content in terms of recoverable metal

State	Ore shipped or concentrated (thousand short tons)	Recoverable metal content: Copper: Thousand pounds	Recoverable metal content: Copper: Percent	Recoverable metal content: Gold (troy ounces)	Recoverable metal content: Silver (troy ounces)	Value gold and silver per ton of ore
Arizona	161,221	1,490,740	0.46	89,765	6,266,783	$0.27
Colorado	11	397	1.81	339	115,404	54.46
Idaho	86	963	.56	82	22,162	1.36
Michigan	8,301	134,024	.81	--	642,944	.36
Montana	23,142	224,616	.49	24,308	3,249,733	.83
Nevada	13,467	113,947	.42	31,643	401,127	.52
New Mexico	26,343	342,043	.65	14,469	1,040,205	.27
Tennessee [1]	1,153	12,607	.55	18	20,053	.08
Utah	35,443	376,061	.53	250,235	2,325,360	1.44
Other States	154	4,484	1.45	7	23,050	.71
Total	269,321	2,699,882	.50	410,866	14,106,821	.49

[1] Copper-zinc ore.

Table 9.—Copper ore concentrated [1] in the United States, by State in 1974, with content in terms of recoverable copper

State	Ore concentrated (thousand short tons)	Recoverable copper content: Thousand pounds	Recoverable copper content: Percent
Arizona	160,981	1,483,449	0.46
Colorado	6	125	.99
Idaho	86	963	.56
Michigan	8,301	134,024	.81
Montana	23,140	224,584	.49
Nevada	13,467	113,947	.42
New Mexico	26,285	341,965	.65
Tennessee [2]	1,153	12,607	.55
Utah	35,443	376,061	.53
Other States	154	4,457	1.45
Total	269,016	2,692,182	.50

[1] Includes following methods of concentration: "Dual process" (leaching followed by by concentration); "LPF" (leach-precipitation-flotation); and froth flotation.

[2] Copper-zinc ore.

Table 10.—Copper ore shipped directly to smelters [1] in the United States, by State in 1974, with content in terms of recoverable copper

State	Ore shipped to smelters		
	Short tons	Recoverable copper content	
		Pounds	Percent
Arizona	239,895	7,290,732	1.52
Colorado	4,669	272,447	2.92
Montana	1,744	31,829	.91
Nevada	57	111	.10
New Mexico	58,243	78,362	.07
Other States	64	26,373	20.60
Total	304,672	7,699,854	1.26

[1] Primarily smelter fluxing material.

Table 11.—Copper precipitates (from dump or in-place leaching) shipped directly to smelters and copper ore leached (heap, vat, or tank) in the United States, by State in 1974, with content in terms of recoverable copper

State	Precipitates shipped (short tons)	Recoverable copper content (pounds)	Ore leached (short tons)	Recoverable copper content (pounds)	Percent
Arizona	74,590	107,385,137	[1] 17,599,767	[2] 112,619,172	0.63
Montana	23,695	37,347,091	--	--	--
Nevada	13,653	19,140,385	6,481,914	34,544,027	.27
New Mexico	31,891	50,007,745	--	--	--
Utah	48,661	78,244,604	39,920	5,887,796	7.37
Other States	68	89,918	--	--	--
Total	192,558	292,214,880	24,121,601	153,050,995	.32

[1] Includes 8,712,485 short tons of ore leached for electrowinning.
[2] Includes 59,986,983 pounds of electrowon copper.

Table 12.—Copper ore smelted and copper ore concentrated in the United States, and average yield in copper, gold, and silver

Year	Smelting ore		Concentrating ore		Total				
	Thousand short tons	Yield in copper, percent	Thousand short tons [1] [2]	Yield in copper, percent	Thousand short tons [1]	Yield in copper, percent	Yield per ton in gold, ounce	Yield per ton in silver, ounce	Value per ton in gold and silver
1970	542	3.51	235,586	0.60	257,729	0.59	0.0023	0.067	$0.20
1971	453	1.76	222,121	.56	242,656	.55	.0022	.059	.18
1972	484	1.68	248,663	.55	266,831	.55	.0019	.059	.21
1973	337	1.40	272,688	.53	289,998	.53	.0018	.058	.32
1974	305	1.26	269,016	.50	293,443	.49	.0014	.048	.45

[1] Includes some ore classed as copper-zinc and minor amount of tailings (1971 excludes tailings).
[2] Excludes tank or vat and heap leaching. (See tables 7 and 11).

Table 13.—Copper produced by primary smelters in the United States

(Short tons)

Year	Domestic	Foreign	Secondary	Total
1970	1,605,265	36,073	78,897	1,720,235
1971	1,470,815	29,181	66,333	1,566,329
1972	1,649,130	41,263	69,017	1,759,410
1973	1,705,065	38,898	77,815	1,821,778
1974	1,532,066	37,750	79,543	1,649,359

Table 14.—Primary and secondary copper produced by primary refineries in the United States

(Short tons)

	1970	1971	1972	1973	1974
PRIMARY					
From domestic ores etc.:[1]					
Electrolytic	1,359,751	1,274,084	1,520,943	1,536,819	1,298,712
Lake	66,091	57,218	70,025	78,179	66,624
Casting	95,341	79,221	89,444	83,339	55,569
Total	1,521,183	1,410,523	1,680,412	1,698,337	1,420,905
From foreign ores, etc.:[1]					
Electrolytic	215,088	167,213	160,781	159,786	202,127
Casting and best select	28,823	14,046	32,040	10,365	31,626
Total refinery production of primary copper	1,765,094	1,591,782	1,873,233	1,868,488	1,654,658
SECONDARY					
Electrolytic[2]	433,394	323,913	341,581	377,523	398,976
Casting	17,623	18,599	16,667	14,290	13,543
Total secondary	451,017	342,512	358,248	391,813	412,519
Grand total	2,216,111	1,934,294	2,231,481	2,260,301	2,067,177

[1] The separation of refined copper into metal of domestic and foreign origin is only approximate, as accurate separation is not possible at this stage of processing.

[2] Includes copper reported from foreign scrap.

Table 15.—Copper cast in forms at primary refineries in the United States

	1973		1974	
	Thousand short tons	Percent	Thousand short tons	Percent
Billets	133	6	101	5
Cakes	147	6	132	6
Cathodes	584	26	661	32
Ingots and ingot bars	196	9	172	8
Wire bars	1,179	52	988	48
Other forms	21	1	13	1
Total	2,260	100	2,067	100

Table 16.—Production, shipments, and stocks of copper sulfate

(Short tons)

Year	Production		Shipments	Stocks Dec. 31[1]
	Quantity	Copper content		
1970	45,352	11,338	40,324	8,812
1971	34,648	8,662	36,852	5,936
1972	38,052	9,513	37,964	5,828
1973	43,360	10,840	44,092	4,580
1974	42,092	10,523	43,598	3,074

[1] Some small quantities are purchased and used by producing companies, so that the figures given do not balance exactly.

Table 17.—Byproduct sulfuric acid[1] (100% basis) produced in the United States

(Short tons)

Year	Copper plants[2]	Lead plants	Zinc plants[3]	Total
1970	747,784	1,090,817		1,838,601
1971	803,284	971,946		1,775,230
1972	1,010,614	859,103		1,869,717
1973	1,088,322	146,591	819,537	2,054,450
1974	1,277,440	132,594	830,969	2,241,003

[1] Includes acid from foreign materials.

[2] Excludes acid made from pyrites concentrates.

[3] Excludes acid made from native sulfur.

Table 18.—Secondary copper produced in the United States

(Short tons)

	1970	1971	1972	1973 r	1974
Copper recovered as unalloyed copper	521,137	429,095	447,409	484,623	513,308
Copper recovered in alloys [1]	726,465	771,025	853,564	892,534	831,012
Total secondary copper	1,247,602	1,200,120	1,300,973	1,377,157	1,344,320
Source:					
New scrap	743,531	754,963	842,779	890,943	860,888
Old scrap	504,071	445,157	458,194	486,214	483,432
Percentage equivalent of domestic mine output	73	79	78	80	84

r Revised.

[1] Includes copper in chemicals, as follows: 1970—2,525; 1971—3,206; 1972—3,038; 1973—3,704; and 1974—2,649.

Table 19.—Copper recovered from scrap processed in the United States by kinds of scrap and form of recovery

(Short tons)

Kind of scrap	1973	1974	Form of recovery	1973	1974
New scrap:			As unalloyed copper:		
Copper-base	r 876,611	846,917	At primary plants	391,813	412,519
Aluminum-base	14,187	13,433	At other plants	92,810	100,789
Nickel-base	131	524			
Zinc-base	14	14	Total	484,623	513,308
Total	r 890,943	860,888	In brass and bronze	848,251	787,118
			In alloy iron and steel	2,712	2,601
Old scrap:			In aluminum alloys	37,581	38,298
Copper-base	r 479,482	476,331	In other alloys	286	351
Aluminum-base	5,939	6,387	In chemical compounds	3,704	2,649
Nickel-base	741	642			
Tin-base	10	8	Total	r 892,534	831,012
Zinc-base	42	64	Grand total	r 1,377,157	1,344,320
Total	r 486,214	483,432			
Grand total	[1] 1,377,157	1,344,320			

r Revised.

Table 20.—Copper recovered as refined copper, in alloys and in other forms from copper-base scrap processed in the United States

(Short tons)

Recovered by—	From new scrap		From old scrap		Total	
	1973	1974	1973	1974	1973	1974
Secondary smelters	68,652	63,904	218,903	212,541	287,555	276,445
Primary copper producers	r 224,585	238,177	r 167,228	180,879	r 391,813	419,056
Brass mills	562,291	523,102	44,500	36,319	606,791	559,421
Foundries and manufacturers	20,434	20,663	46,121	44,702	66,555	65,365
Chemical plants	649	1,071	2,730	1,890	3,379	2,961
Total	r 876,611	846,917	r 479,482	476,331	r 1,356,093	1,323,248

r Revised.

Table 21.—Production of secondary copper and copper-alloy products in the United States

(Short tons)

Item produced from scrap	1973	1974
UNALLOYED COPPER PRODUCTS		
Refined copper by primary producers	391,813	412,519
Refined copper by secondary smelters	73,310	84,389
Copper powder	19,438	16,329
Copper castings	62	71
Total	484,623	513,308
ALLOYED COPPER PRODUCTS		
Brass and bronze ingots:		
Tin bronzes	41,949	40,210
Leaded red brass and semired brass	149,165	128,250
High-leaded tin bronze	29,368	33,192
Yellow brass	20,857	15,328
Manganese bronze	12,126	11,664
Aluminum bronze	6,963	8,359
Nickel silver	3,744	3,907
Silicon bronze and brass	4,586	4,445
Copper-base hardeners and master alloys	15,724	16,198
Total	284,482	261,553
Brass-mill products	764,372	702,688
Brass and bronze castings	36,570	40,162
Brass powder	906	812
Copper in chemical products	3,704	2,649
Grand total	1,574,657	1,521,172

Table 22.—Composition of secondary copper-alloy production

(Short tons)

	Copper	Tin	Lead	Zinc	Nickel	Aluminum	Total
Brass and bronze production:[1]							
1973	223,217	12,530	17,968	29,357	1,309	101	284,482
1974	201,911	12,541	18,137	28,227	665	72	261,553
Secondary metal content of brass-mill products:							
1973	600,543	488	3,584	149,188	10,470	99	764,372
1974	562,196	455	3,255	132,554	4,168	60	702,688
Secondary metal content of brass and bronze castings:							
1973	30,422	1,026	2,330	2,711	6	75	36,570
1974	32,835	1,088	2,684	3,536	8	61	40,162

[1] About 92% from scrap and 8% from other than scrap.

Table 23.—Stocks and consumption of purchased copper scrap in the United States in 1974

(Short tons)

Class of consumer and type of scrap	Stocks Jan. 1	Receipts	Consumption			Stocks Dec. 31
			New scrap	Old scrap	Total	
SECONDARY SMELTERS						
No. 1 wire and heavy copper	2,057	32,099	3,936	27,503	31,439	2,717
No. 2 wire, mixed heavy and light copper	2,954	70,998	19,789	51,628	71,417	2,535
Composition or red brass	3,907	75,189	17,143	57,774	74,917	4,179
Railroad-car boxes	404	1,191	--	1,366	1,366	229
Yellow brass	5,343	51,843	5,794	46,199	51,993	5,193
Cartridge cases and brass	40	132	--	100	100	72
Auto radiators (unsweated)	3,634	60,357	--	60,426	60,426	3,565
Bronze	2,074	25,459	4,469	21,643	26,112	1,421
Nickel silver and cupronickel	622	4,412	431	3,772	4,203	831
Low brass	322	2,864	1,766	878	2,644	542
Aluminum bronze	124	553	444	139	583	94
Low-grade scrap and residues	13,027	60,132	49,135	9,992	59,127	14,032
Total	34,508	385,229	102,907	281,420	384,327	35,410
PRIMARY PRODUCERS						
No. 1 wire and heavy copper	2,824	137,815	71,846	66,249	138,095	2,544
No. 2 wire, mixed heavy and light copper	8,077	199,674	147,404	56,011	203,415	4,336
Refinery brass	18,193	10,334	4,932	5,021	9,953	20,132
Low-grade scrap and residues		252,927	68,210	183,159	251,369	
Total	29,094	600,750	292,392	310,440	602,832	27,012
BRASS MILLS [1]						
No. 1 wire and heavy copper	16,661	205,290	171,052	34,238	205,290	10,938
No. 2 wire, mixed heavy and light copper	3,886	59,672	57,970	1,702	59,672	4,316
Yellow brass	20,959	299,061	299,061	--	299,061	22,321
Cartridge cases and brass	5,607	77,350	76,260	1,090	77,350	8,543
Bronze	869	5,319	5,319	--	5,319	1,272
Nickel silver and cupronickel	3,717	35,930	35,930	--	35,930	7,110
Low brass	4,434	27,869	27,869	--	27,869	4,946
Aluminum bronze	9	398	398	--	398	29
Total [1]	56,142	710,889	673,859	37,030	710,889	59,475
FOUNDRIES, CHEMICAL PLANTS, AND OTHER MANUFACTURERS						
No. 1 wire and heavy copper	3,723	36,829	13,231	23,288	36,519	4,033
No. 2 wire, mixed heavy and light copper	1,443	10,358	3,565	7,014	10,579	1,222
Composition or red brass	789	6,969	2,302	4,577	6,879	879
Railroad-car boxes	168	6,851	--	6,741	6,741	278
Yellow brass	664	7,318	4,770	2,467	7,237	745
Auto radiators (unsweated)	1,582	8,343	--	8,789	8,789	1,136
Bronze	134	666	170	552	722	78
Nickel silver and cupronickel	1	6	--	7	7	--
Low brass	53	852	367	482	849	56
Aluminum bronze	55	520	62	454	516	59
Low-grade scrap and residues	416	600	141	502	643	373
Total	9,028	79,312	[2] 24,608	[2] 54,873	[2] 79,481	8,859
GRAND TOTAL						
No. 1 wire and heavy copper	25,265	412,033	260,065	151,278	411,343	20,232
No. 2 wire, mixed heavy and light copper	16,360	340,702	228,728	116,355	345,083	12,409
Composition or red brass	4,696	82,158	19,445	62,351	81,796	5,058
Railroad-car boxes	572	8,042	--	8,107	8,107	507
Yellow brass	26,966	358,222	309,625	48,666	358,291	28,259
Cartridge cases and brass	5,647	77,482	76,260	1,190	77,450	8,615
Auto radiators (unsweated)	5,216	68,700	--	69,215	69,215	4,701
Bronze	3,077	31,444	9,958	22,195	32,153	2,771
Nickel silver and cupronickel	4,340	40,348	36,361	3,779	40,140	7,941
Low brass	4,809	31,585	30,002	1,360	31,362	5,544
Aluminum bronze	188	1,471	904	593	1,497	182
Low-grade scrap and residues [3]	31,636	323,993	122,418	198,674	321,092	34,537
Total	128,772	1,776,180	1,093,766	683,763	1,777,529	130,756

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[1] Brass-mill stocks include home scrap; purchased scrap consumption assumed equal to receipts, so lines in brass-mill and grand total sections do not balance.

[2] Of the totals shown, chemical plants reported the following: Unalloyed copper scrap, 1,120 tons new and 2,177 old.

[3] Includes refinery brass.

Table 24.—Consumption of copper and brass materials in the United States by principal consuming groups

(Short tons)

Year and item	Primary producers	Brass mills	Wire mills	Foundries, chemical plants, and miscellaneous users	Secondary smelters	Total
1973:						
Copper scrap	603,830	776,714	--	80,462	402,123	1,863,129
Refined copper[1]	--	714,438	1,672,255	39,760	10,595	2,437,048
Brass ingot	--	14,473	--	[2] 285,531	--	300,004
Slab zinc	--	185,878	--	3,137	8,635	197,650
Miscellaneous	--	--	--	200	12,987	13,187
1974:						
Copper scrap	602,832	710,889	--	79,481	384,327	1,777,529
Refined copper[1]	--	670,158	1,474,340	40,486	9,184	2,194,168
Brass ingot	--	23,902	--	[2] 260,828	--	284,730
Slab zinc	--	170,669	--	3,631	7,263	181,563
Miscellaneous	--	--	--	200	13,167	13,367

[1] Detailed information on consumption of refined copper will be found in table 28.
[2] Shipments to foundries by smelters plus decrease in stocks at foundries.

Table 25.—Foundry consumption of brass ingot, by type, in the United States

(Short tons)

	1970 r	1971 r	1972 r	1973 r	1974
Tin bronzes	46,829	43,527	51,181	59,924	59,752
Leaded red brass and semired brass	128,626	132,469	147,925	139,375	120,468
Yellow brass	74,689	100,398	106,586	123,625	109,119
Manganese bronze	14,513	8,525	10,200	11,223	9,937
Hardeners and master alloys	5,174	5,527	7,061	6,855	6,096
Nickel silver	3,265	3,466	2,838	2,908	3,104
Aluminum bronze	7,809	7,401	6,875	8,323	8,456
Total	280,905	301,313	332,666	352,233	316,932

r Revised.

Table 26.—Foundry consumption of brass ingot by type, refined copper, and copper scrap, in the United States in 1974, by geographic division and State

(Short tons)

Geographic division and State	Tin bronzes	Leaded red brass and semi-red brass	Yellow brass	Man-ganese bronze	Hardeners and master alloys	Nickel silver	Alumi-num bronze	Total brass ingot	Refined copper con-sumed	Copper scrap con-sumed
New England:										
Connecticut	1,288	3,733	1,572	82	10	243	617	7,303	1,531	708
Massachusetts	1,323	3,971	874	265	14		32	6,721	582	103
Maine, New Hampshire, Rhode Island, Vermont	196	1,534	338	234	10	179	107	2,598	4	--
Total	2,807	9,238	2,784	581	34	422	756	16,622	2,117	811
Middle Atlantic:										
New Jersey	590	1,452	278	236	161	36	102	2,855	2,559	3,475
New York	5,590	4,321	1,294	353	42	313	454	12,367	1,817	3,804
Pennsylvania	6,875	10,372	2,062	1,068	1,757	1,136	1,831	25,101	6,262	6,379
Total	13,055	16,145	3,634	1,657	1,960	1,485	2,387	40,323	10,638	13,658
East North Central:										
Illinois	3,432	14,539	1,285	822	139	44	1,086	21,347	1,332	3,706
Indiana	4,065	10,410	1,610	340	1,599	287	63	18,374	1,212	10,060
Michigan	6,444	10,036	73,322	1,816	151	6	1,319	93,094	9,707	1,104
Ohio	15,983	12,077	11,209	1,387	329	15	437	41,437	3,145	8,837
Wisconsin	961	7,610	3,712	164	1,558	550	175	14,730	7,285	935
Total	30,885	54,672	91,138	4,529	3,776	902	3,080	188,982	22,681	24,642
West North Central:										
Iowa, Kansas, Minnesota	1,695	4,021	322	786	77	14	100	7,014	370	1,910
Missouri, Nebraska, South Dakota	214	1,372	1,756	248	4		68	3,663	211	2,308
Total	1,909	5,393	2,078	1,034	81	14	168	10,677	581	4,218
South Atlantic:										
Delaware, District of Columbia, Florida, Georgia, Maryland	801	1,145	79	99	5	1	84	2,210	350	5,005
North Carolina, South Carolina, Virginia, West Virginia	2,696	4,715	677	115			318	8,525	86	
Total	3,497	5,860	756	214	5	1	402	10,735	436	5,005
East South Central:										
Alabama, Kentucky, Mississippi, Tennessee	2,626	8,296	4,281	806	133	140	103	16,385	1,319	10,101
West South Central:										
Arkansas, Louisiana, Oklahoma, Texas	2,192	2,359	2,185	358	10	72	1,184	8,360	1,344	1,352
Mountain:										
Arizona, Colorado, Idaho, Montana, Nevada, New Mexico, Utah	271	310	145	91	--	--	7	824	172	657
Pacific:										
California	2,227	16,777	2,102	558	88	64	262	22,078	226	13,212
Oregon and Washington	283	1,418	16	109	9	4	107	1,946	257	2,528
Total	2,510	18,195	2,118	667	97	68	369	24,024	483	15,740
Grand total	59,752	120,468	109,119	9,937	6,096	3,104	8,456	316,932	39,771	76,184

Table 27.—Primary refined copper supply and withdrawals on domestic account

(Short tons)

	1970	1971	1972	1973	1974
Production from domestic and foreign ores, etc	1,765,094	1,591,782	1,873,233	1,868,488	1,654,658
Imports [1]	132,143	163,988	192,379	r 202,955	313,569
Stocks Jan. 1 [1]	89,000	130,000	75,000	57,000	37,000
Total available supply	1,986,237	1,885,770	2,140,612	r 2,128,443	2,005,227
Copper exports [1]	221,211	187,654	182,743	189,396	126,526
Stocks Dec. 31 [1]	130,000	75,000	57,000	37,000	101,000
Total	351,211	262,654	239,743	226,396	227,526
Apparent withdrawals on domestic account [2]	1,585,000	1,623,000	1,901,000	r 1,902,000	1,778,000

r Revised.

[1] May include some copper refined from scrap.

[2] Excludes copper, if any, delivered to industry from national stockpile sales.

Table 28.—Refined copper consumed by class of consumer

(Short tons)

Year and class of consumer	Cathodes	Wire bars	Ingots and ingot bars	Cakes and slabs	Billets	Other	Total
1973:							
Wire mills	334,317	1,315,130	W	W	W	22,808	1,672,255
Brass mills	186,110	37,985	124,147	193,094	172,752	350	714,438
Chemical plants	--	--	28	--	--	1,202	1,225
Secondary smelters	6,193	--	4,212	W	W	190	10,595
Foundries	2,230	1,241	10,425	W	W	905	14,801
Miscellaneous [1]	2,375	1,675	8,992	351	1,909	8,432	23,734
Total	531,225	1,356,031	147,799	193,445	174,661	33,887	2,437,048
1974:							
Wire mills	365,111	1,101,675	W	--	--	7,554	1,474,340
Brass mills	205,803	32,023	117,791	177,663	136,878	--	670,158
Chemical plants	--	--	W	--	--	715	715
Secondary smelters	5,142	W	3,097	W	W	945	9,184
Foundries	1,725	1,508	15,494	W	W	631	19,358
Miscellaneous [1]	1,873	1,521	6,721	346	1,713	8,239	20,413
Total	579,654	1,136,727	143,103	178,009	138,591	18,084	2,194,168

W Withheld to avoid disclosing individual company confidential data; included in "Other."

[1] Includes iron and steel plants, primary smelters producing alloys other than copper, consumers of copper powder and copper shot, and miscellaneous manufacturers.

Table 29.—Stocks of copper at primary smelting and refining plants in the United States, Dec. 31

(Thousand short tons)

Year	Refined copper [1]	Blister and materials in process of refining [2]
1970	130	340
1971	75	303
1972	57	281
1973	37	265
1974	101	324

[1] May include some copper refined from scrap.

[2] Includes copper in transit from smelters in the United States to refineries therein.

Table 30.—Stocks of copper in fabricators' hands Dec. 31

(Short tons)

Year	Stocks of refined copper[1] (1)	Unfilled purchases of refined copper from producers (2)	Working stocks (3)	Unfilled sales to customers (4)	Excess stocks over orders booked[2] (5)
1970	515,096	86,925	438,925	156,007	7,089
1971	510,810	96,209	431,348	187,688	−12,017
1972	460,062	91,845	392,920	178,121	−19,134
1973	419,006	87,590	373,506	296,574	−163,484
1974	495,991	118,360	379,741	197,131	37,479

[1] Includes in-process metal and primary fabricated shapes. Also includes small quantities of refined copper held at refineries for fabricators' account.
[2] Columns (1) plus (2) minus (3) and minus (4) equal column (5).

Source: United States Copper Association.

Table 31.—Dealers' monthly average buying price for copper scrap and consumers' alloy-ingot prices at New York in 1974

(Cents per pound)

Grade	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Average
No. 2 copper scrap	60.50	66.39	72.79	75.91	73.66	60.60	51.40	49.20	41.30	38.67	35.12	33.07	54.88
No. 1 composition scrap	47.50	49.26	49.33	53.34	53.68	50.45	45.86	44.09	36.55	33.65	31.31	30.07	43.76
No. 1 composition ingot	76.25	79.34	88.48	96.86	100.50	96.69	92.47	87.00	80.54	74.26	71.49	70.00	84.49

Source: Metal Statistics, 1975.

Table 32.—Average monthly quoted prices of electrolytic copper for domestic delivered, in the United States and for spot copper at London

(Cents per pound)

Month	1973			1974		
	Domestic delivered		London spot[1] Metals Week	Domestic delivered		London spot[1] Metals Week
	American Metal Market	Metals Week		American Metal Market	Metals Week	
January	52.41	52.39	50.73	68.70	68.75	92.12
February	54.55	54.57	56.38	68.70	68.58	103.80
March	59.85	59.81	68.43	68.70	68.58	124.44
April	60.12	60.08	71.96	68.70	68.58	137.50
May	60.12	60.08	70.36	81.19	81.46	130.35
June	60.12	60.08	79.28	86.09	86.24	110.60
July	60.12	60.08	91.62	86.31	86.60	87.03
August	60.12	60.08	94.74	86.31	86.60	81.74
September	60.12	60.08	87.75	83.01	83.66	66.20
October	60.12	60.08	93.61	78.23	78.43	63.40
November	60.12	60.16	102.90	75.79	76.25	64.13
December	66.56	66.37	100.93	73.03	73.57	58.43
Average	59.53	59.49	80.86	77.06	77.27	93.13

[1] Based on average monthly rates of exchange.

Table 33.—Average weighted prices of copper delivered

(Cents per pound)

Year	Domestic copper	Foreign copper
1970	58.2	64.1
1971	52.0	49.3
1972	51.2	48.6
1973	59.5	[1] 80.8
1974	77.3	93.5

[1] Correction.

Source: Metals Week.

Table 34.—U.S. exports of copper, by class and country

Year and country	Ore, concentrates, and matte (copper content)		Ash and residues (copper content)		Refined		Scrap		Blister	
	Quantity (short tons)	Value (thousands)	Quantity (short tons)	Value (thousands)	Quantity (short tons)	Value (thousands)	Quantity (short tons)	Value (thousands)	Quantity (short tons)	Value (thousands)
1973	23,508	$30,147	15,087	$10,296	189,396	$245,007	42,286	$38,675	7,362	$8,069
1974:										
Africa	--	--	--	--	--	--	24	50	--	--
Argentina	--	--	--	--	302	570	409	920	--	--
Belgium-Luxembourg	821	728	3,704	3,824	2,459	3,941	7,998	7,664	1,099	1,054
Brazil	--	--	36	50	23,990	43,570	658	1,157	--	--
Canada	891	819	1,078	760	11,428	18,839	8,652	10,563	679	1,162
Denmark	--	--	--	--	338	502	11	6	--	--
Finland	317	732	--	--	110	288	--	--	--	--
France	--	--	72	58	19,068	34,603	42	41	8	7
Germany, West	424	881	1,247	1,415	11,716	20,530	3,193	4,601	41	109
India	--	--	--	--	53	98	--	--	--	--
Israel	--	--	--	--	7	18	--	--	--	--
Italy	--	--	295	234	26,519	48,328	837	909	--	--
Japan	15,778	13,138	186	413	4,044	7,590	2,157	2,763	8	6
Korea, Republic of	--	--	104	130	1,941	3,211	7,667	9,612	--	--
Mexico	6	8	--	--	584	1,223	1,185	1,527	73	74
Netherlands	7	6	334	152	4,354	8,526	773	679	--	--
Oceania	--	--	--	--	90	192	--	--	--	--
Pakistan	--	--	--	--	50	98	--	--	--	--
Philippines	--	--	--	--	1,426	2,293	--	--	--	--
Spain	870	991	696	670	51	94	2,042	1,529	--	--
Sweden	--	--	--	--	1,388	3,155	349	384	--	
Switzerland	--	--	--	--	432	830	143	192	--	--
Taiwan	--	--	56	7	1,128	2,166	2,914	1,100	(1)	1
Thailand	170	34	--	--	59	88	--	--	--	--
United Kingdom	16	11	329	125	14,541	26,140	741	1,055	742	1,188
Venezuela	--	--	--	--	173	340	852	736	5	5
Other	23	44	96	26	275	476	695	925	5	12
Total	19,323	17,387	8,233	7,864	126,526	227,704	41,342	46,413	2,660	3,568

See footnote at end of table.

Table 34.—U.S. exports of copper, by class and country—Continued

Year and country	Pipes and tubing		Plates and sheets		Wire and cable, bare		Wire and cable, insulated		Other copper manufactures [2]	
	Quantity (short tons)	Value (thousands)	Quantity (short tons)	Value (thousands)	Quantity (short tons)	Value (thousands)	Quantity (short tons)	Value (thousands)	Quantity (short tons)	Value (thousands)
1973	7,744	$15,797	474	$1,013	5,196	$7,832	40,046	$108,344	7,481	$12,160
1974:										
Africa	225	770	6	16	579	1,474	1,034	4,008	62	122
Argentina	--	--	--	--	8	13	41	724	48	124
Belgium-Luxembourg	49	128	--	--	45	68	701	2,732	50	123
Brazil	28	103	--	--	163	224	187	1,095	57	73
Canada	1,543	3,949	380	908	887	1,511	25,901	74,234	2,111	3,771
Denmark	13	35	--	--	29	24	145	1,197	--	--
Finland	4	23	--	--	113	206	23	105	79	183
Germany, West	412	911	4	8	46	135	492	1,515	67	146
France	1,167	2,951	18	47	25	66	422	2,803	10	11
India	23	61	--	--	4	5	827	1,437	--	--
Israel	368	1,053	20	64	71	250	2,228	5,188	48	156
Italy	--	--	1	3	24	90	387	2,062	23	41
Japan	579	1,527	69	205	68	203	658	3,171	927	2,060
Korea, Republic of	13	35	--	--	21	68	784	1,817	2	3
Mexico	293	728	29	160	660	1,181	9,012	25,545	12	31
Netherlands	231	558	5	13	54	106	182	1,199	61	79
Oceania	16	60	87	205	27	52	494	1,963	23	61
Pakistan	9	26	4	19	43	78	1,105	2,821	30	63
Philippines	192	610	9	32	21	72	778	1,522	29	57
Spain	108	270	--	--	433	332	122	776	22	30
Sweden	45	125	--	--	72	125	140	851	22	49
Switzerland	4	8	--	--	2	3	101	402	119	195
Taiwan	134	460	19	64	90	201	622	2,662	4	6
Thailand	28	85	--	--	1	1	518	1,462	5	12
United Kingdom	257	731	42	91	197	355	1,155	5,288	129	270
Venezuela	29	109	29	91	53	137	223	1,032	2,937	6,950
Other	968	3,060	71	250	1,896	4,458	14,232	41,279	1,455	2,967
Total	6,738	18,376	793	2,176	5,632	11,438	62,514	188,890	8,332	17,583

[1] Less than ½ unit.
[2] Does not include wire cloth: 1973, 2,017,365 square feet ($458,740); 1974, 1,954,750 square feet ($869,778).

Table 35.—U.S. exports of copper, by class

	Ore, concentrate and matte (copper content)		Blister		Refined copper and semimanufactures	
	Quantity (short tons)	Value (thousands)	Quantity (short tons)	Value (thousands)	Quantity (short tons)	Value (thousands)
1972	17,662	$14,167	8,569	$6,680	215,591	$278,059
1973	23,508	30,147	7,362	8,069	242,856	386,993
1974	19,323	17,387	2,660	3,568	202,203	448,584

	Other copper manufactures [1]		Total	
	Quantity (short tons)	Value (thousands)	Quantity (short tons)	Value (thousands)
1972	6,299	$7,400	248,121	$306,306
1973	7,431	12,160	281,157	437,369
1974	8,332	17,583	232,518	487,122

[1] Does not include wire cloth: 1972, 908,651 square feet ($450,713); 1973, 2,017,365 square feet ($458,740); 1974, 1,954,750 square feet ($869,778).

Table 36.—U.S. exports of copper-base alloy (including brass and bronze), by class

Class	1973		1974	
	Quantity (short tons)	Value (thousands)	Quantity (short tons)	Value (thousands)
Ingots	443	$1,635	705	$1,972
Scrap and waste	110,355	105,482	118,198	126,751
Bars, rods, and shapes	8,711	13,814	15,227	31,189
Plates, sheets, and strips	6,099	18,997	7,249	29,437
Pipes and tubing	6,854	14,356	8,026	23,907
Pipe fittings	10,036	26,820	9,827	31,409
Plumbers' brass goods	1,996	6,154	2,104	7,818
Welding rods and wire	1,792	5,228	4,190	13,987
Castings and forgings	701	1,369	987	2,409
Powder and flakes	2,487	4,954	2,722	7,243
Foil	414	1,113	286	1,453
Articles of copper and copper-base alloys, n.e.c	(1)	5,327	(1)	7,264
Total	149,888	205,249	169,521	284,839

[1] Quantity not reported.

Table 37.—U.S. exports of unfabricated copper-base alloys [1] ingots, bars, rods, shapes, plates, sheets, and strip

Year	Quantity (short tons)	Value (thousands)
1972	11,291	$21,902
1973	15,253	34,446
1974	23,181	62,598

[1] Includes brass and bronze.

Table 38.—U.S. exports of copper sulfate (blue vitriol)

Year	Quantity (short tons)	Value (thousands)
1972	2,646	$1,767
1973	1,716	2,043
1974	1,815	2,138

Table 39.—U.S. exports of copper scrap, by country

Country	Unalloyed copper scrap				Copper alloy scrap			
	1973		1974		1973		1974	
	Quantity (short tons)	Value (thousands)	Quantity (short tons)	Value (thousands)	Quantity (short tons)	Value (thousands)	Quantity (short tons)	Value (thousands)
Argentina	--	--	409	$920	--	--	409	$577
Belgium-Luxembourg	9,795	$4,575	7,998	7,664	8,079	$7,602	9,617	10,815
Brazil	253	382	658	1,157	1,282	1,489	3,253	4,789
Canada	8,074	8,164	8,652	10,563	10,564	10,641	9,120	10,118
Denmark	--	--	11	6	--	--	47	47
France	1	1	42	41	113	129	502	534
Germany:								
East	155	164	21	34	--	--	128	189
West	3,091	3,770	3,193	4,601	10,436	10,741	12,113	15,227
Hong Kong	20	26	207	290	146	156	626	739
Israel	20	23	--	--	428	423	20	19
Italy	955	866	837	909	8,490	7,255	18,285	19,641
Japan	5,310	5,769	2,157	2,768	44,947	43,585	24,779	29,077
Korea, Republic of	6,026	7,457	7,667	9,612	9,542	10,544	12,422	13,510
Mexico	737	957	1,185	1,527	238	209	311	290
Netherlands	943	701	773	679	1,394	1,450	3,609	4,177
Norway	--	--	323	394	--	--	60	81
Pakistan	--	--	--	--	350	274	62	67
South Africa, Republic of	--	--	--	--	60	45	255	241
Spain	2,324	1,486	2,042	1,529	1,585	1,308	4,120	4,023
Sweden	142	116	349	384	1,310	882	1,809	1,477
Switzerland	22	31	143	192	60	60	766	818
Taiwan	1,264	925	2,914	1,100	3,649	1,862	9,850	3,233
United Kingdom	2,870	2,906	741	1,055	7,229	6,599	5,192	6,713
Venezuela	--	--	852	736	153	45	615	138
Yugoslavia	183	221	63	69	--	--	--	--
Other	101	135	105	188	300	183	228	211
Total	42,286	38,675	41,342	46,413	110,355	105,482	118,198	126,751

Table 40.—U.S. imports for consumption of copper scrap, by country

Country	Unalloyed copper scrap (copper content)			
	1973		1974	
	Quantity (short tons)	Value (thousands)	Quantity (short tons)	Value (thousands)
Australia	--	--	198	$310
Bahamas	41	$33	21	16
Belgium-Luxembourg	192	357	826	1,400
Canada	r 11,753	r 15,865	12,779	22,279
Chile	--	--	242	479
Dominican Republic	r 323	r 352	386	535
France	136	222	290	638
Germany, West	r 223	r 345	1,427	2,691
Guatemala	149	126	52	131
Honduras	107	94	42	62
Hong Kong	1	1	1,137	1,325
Jamaica	141	123	113	145
Japan	156	46	4,259	8,245
Mexico	r 4,710	r 3,988	6,188	7,407
Netherlands	r 174	r 670	484	884
Netherlands Antilles	19	21	217	279
Nicaragua	93	100	361	556
Panama	82	85	275	365
Switzerland	84	70	327	577
Trinidad and Tobago	r 54	r 62	19	28
United Kingdom	r 532	r 966	214	442
Other	11	14	1,252	1,846
Total	r 18,981	r 23,540	31,109	50,640

Country	Copper alloy scrap					
	1973			1974		
	Gross weight (short tons)	Content (short tons)	Value (thousands)	Gross weight (short tons)	Content (short tons)	Value (thousands)
Australia	--	--	--	40	38	$50
Bahamas	114	76	$69	183	119	108
Belgium-Luxembourg	45	26	51	82	58	89
Canada	r 10,281	r 6,703	r 10,042	11,507	7,565	16,443
Dominican Republic	295	249	222	166	123	161
Finland	80	58	95	--	--	--
Germany, West	r 173	r 108	r 190	236	143	301
Guatemala	140	107	65	61	46	43
Haiti	--	--	--	29	22	34
Hong Kong	229	200	244	1,057	721	1,531
Israel	--	--	--	59	52	71
Jamaica	9	8	6	30	20	26
Japan	69	43	61	564	320	578
Mexico	436	340	366	754	510	721
Netherlands	88	71	127	181	135	268
Netherlands Antilles	18	15	19	172	96	132
Nicaragua	37	33	46	55	38	53
Panama	69	52	47	78	59	88
Sudan	--	--	--	87	61	130
Switzerland	58	33	67	295	183	365
Trinidad and Tobago	119	83	84	83	67	98
United Kingdom	20	17	17	21	13	30
Other	1	(1)	(1)	150	108	181
Total	r 12,281	r 8,222	r 11,818	15,890	10,497	21,501

r Revised.

[1] Less than ½ unit.

Table 41.—U.S. imports[1] of unmanufactured copper (copper content), by class and country

Year and country	Ore, concentrates		Matte		Blister	
	Quantity (short tons)	Value (thousands)	Quantity (short tons)	Value (thousands)	Quantity (short tons)	Value (thousands)
1972	53,655	$49,036	1,358	$1,087	157,432	$144,764
1973:						
Australia	1,531	1,466	--	--	--	--
Belgium-Luxembourg	--	--	--	--	--	--
Canada	11,291	9,419	292	123	1,181	1,236
Chile	1,654	555	--	--	29,617	34,619
Colombia	7	3	--	--	--	--
France	--	--	--	--	--	--
Germany, West	--	--	--	--	2	4
Italy	28	10	--	--	--	--
Japan	--	--	--	--	11	16
Mexico	682	236	431	393	8,799	11,046
Netherlands	--	--	--	--	--	--
Nicaragua	200	226	--	--	--	--
Norway	--	--	--	--	--	--
Peru	8,697	13,846	--	--	86,896	123,011
Philippines	r 19,042	r 28,786	--	--	--	--
Poland	--	--	--	--	--	--
South Africa, Republic of	--	--	--	--	26,279	27,569
Sweden	--	--	--	--	--	--
Tanzania	--	--	--	--	--	--
Uganda	--	--	--	--	110	98
U.S.S.R	--	--	--	--	272	273
United Kingdom	--	--	23	26	(2)	1
Venezuela	203	160	--	--	--	--
Yugoslavia	--	--	--	--	937	917
Zambia	--	--	--	--	--	--
Other	--	--	--	--	--	--
Total	r 43,335	r 54,707	746	542	154,104	198,790
1974:						
Australia	2,379	3,219	--	--	--	--
Belgium-Luxembourg	--	--	--	--	--	--
Botswana	--	--	625	3,018	--	--
Canada	19,907	26,876	155	81	3	4
Chile	--	--	7	14	65,093	126,897
France	--	--	--	--	--	--
Germany, West	--	--	--	--	--	--
Honduras	4,595	1,695	--	--	--	--
Hong Kong	--	--	--	--	--	--
Japan	--	--	--	--	94	231
Kenya	--	--	--	--	3,081	5,461
Mexico	2,069	1,288	--	--	7,644	17,396
Netherlands	--	--	--	--	17	5
Nicaragua	2,771	1,034	--	--	--	--
Norway	--	--	--	--	--	--
Peru	7,284	14,918	--	--	94,686	171,612
Philippines	14,244	27,206	--	--	--	--
Poland	--	--	--	--	--	--
South Africa, Republic of	--	--	1,754	9,080	37,211	71,946
U.S.S.R	--	--	--	--	--	--
United Kingdom	166	265	--	--	1	1
Yugoslavia	--	--	--	--	--	--
Zambia	--	--	--	--	--	--
Other	6	3	83	100	--	--
Total	53,421	76,504	2,624	12,293	207,830	393,553

See footnotes at end of table.

Table 41.—U.S. imports[1] of unmanufactured copper (copper content), by class and country—Continued

Year and country	Refined		Scrap		Total	
	Quantity (short tons)	Value (thousands)	Quantity (short tons)	Value (thousands)	Quantity (short tons)	Value (thousands)
1972	192,379	$188,883	10,787	$9,766	415,611	$393,536
1973:						
Australia	498	1,071	--	--	2,029	2,537
Belgium-Luxembourg	[r] 9,982	[r] 17,548	192	357	[r] 10,174	[r] 17,900
Canada	[r] 130,553	[r] 157,571	[r] 12,104	[r] 16,228	[r] 155,421	[r] 184,577
Chile	27,492	38,703	--	--	58,763	73,877
Colombia	--	--	--	--	7	3
France	805	1,388	136	222	941	1,610
Germany, West	8,627	15,878	[r] 223	[r] 345	[r] 8,852	[r] 16,227
Italy	--	--	--	--	28	10
Japan	22	20	156	46	189	82
Mexico	2,132	2,608	[r] 4,766	[r] 4,063	[r] 16,810	[r] 18,346
Netherlands	[r] 2,110	[r] 3,222	[r] 174	[r] 670	[r] 2,284	[r] 3,892
Nicaragua	--	--	93	100	298	326
Norway	306	365	--	--	306	365
Peru	4,384	4,959	--	--	99,977	141,816
Philippines	--	--	--	--	[r] 19,042	[r] 28,786
Poland	689	1,140	--	--	689	1,140
South Africa, Republic of	81	74	--	--	26,360	27,643
Sweden	339	583	--	--	339	583
Tanzania	901	1,621	--	--	901	1,621
Uganda	--	--	--	--	110	98
U.S.S.R	--	--	--	--	272	273
United Kingdom	[r] 7,726	[r] 9,216	[r] 532	[r] 966	[r] 8,281	[r] 10,209
Venezuela	--	--	--	--	203	160
Yugoslavia	[r] 716	[r] 742	--	--	[r] 1,653	[r] 1,659
Zambia	5,455	5,279	--	--	5,455	5,279
Other	137	146	[r] 997	[r] 982	[r] 1,134	[r] 1,128
Total	[r] 202,955	[r] 262,129	[r] 19,373	[r] 23,979	[r] 420,513	[r] 540,147
1974:						
Australia	83	140	198	310	2,660	3,669
Belgium-Luxembourg	8,024	15,915	826	1,400	8,850	17,315
Botswana	--	--	--	--	625	3,018
Canada	118,429	190,378	12,828	22,355	151,322	239,689
Chile	66,549	119,837	242	479	131,891	247,227
France	664	1,343	290	638	954	1,981
Germany, West	7,177	13,290	1,427	2,691	8,604	15,981
Honduras	--	--	42	62	4,637	1,757
Hong Kong	22	34	1,137	1,325	1,159	1,359
Japan	73,055	136,988	4,259	8,245	77,408	145,464
Kenya	--	--	85	126	3,166	5,587
Mexico	873	1,396	6,188	7,407	16,774	27,487
Netherlands	3,253	5,651	484	884	3,754	6,540
Nicargua	--	--	361	556	3,132	1,590
Norway	294	666	39	72	333	738
Peru	6,913	12,495	22	32	108,905	199,057
Philippines	--	--	34	55	14,278	27,261
Poland	2,192	4,162	--	--	2,192	4,162
South Africa, Republic of	110	143	--	--	39,075	81,169
U.S.S.R	1,102	1,762	--	--	1,102	1,762
United Kingdom	6,643	13,044	214	442	7,024	13,752
Yugoslavia	14,844	28,357	222	100	15,066	28,457
Zambia	2,825	5,160	--	--	2,825	5,160
Other	517	970	2,260	3,538	2,866	4,611
Total	313,569	551,726	31,158	50,717	608,602	1,084,793

[r] Revised.

[1] Data are general imports, that is, they include copper imported for immediate consumption plus material entering the country under bond.

[2] Less than ½ unit.

Table 42.—U.S. imports for consumption of copper (copper content) by class

Year	Ore and concentrates		Matte		Blister	
	Quantity (short tons)	Value (thousands)	Quantity (short tons)	Value (thousands)	Quantity (short tons)	Value (thousands)
1972	80,740	$81,055	1,453	$1,134	77,162	$72,514
1973	19,582	16,029	139	106	128,166	159,922
1974	84,981	130,269	2,426	12,033	200,607	383,491

Year	Refined		Scrap		Total value (thousands)
	Quantity (short tons)	Value (thousands)	Quantity (short tons)	Value (thousands)	
1972	175,703	$172,772	10,787	$9,766	$337,241
1973	[r] 207,739	[r] 264,967	[r] 19,018	[r] 23,540	[r] 464,564
1974	318,349	551,442	31,109	50,640	1,127,875

[r] Revised.

Table 43.—Copper: World mine production by country[1]

(Short tons)

Country	1972	1973	1974[p]
North and Central America:			
Canada[2]	793,303	908,240	928,550
Cuba[e]	3,800	5,500	6,500
Dominican Republic[e]	500	500	500
Mexico	86,774	88,737	91,128
Nicaragua[3]	2,412	1,703	1,957
United States[2]	1,664,840	1,717,940	1,593,590
South America:			
Argentina	[r] 1,240	313	[e] 330
Bolivia[4]	[r] 9,159	9,432	8,962
Brazil	[r] 4,911	3,761	[e] 4,400
Chile	[r] 790,136	810,639	994,394
Colombia	71	[e] 80	[e] 80
Ecuador	483	335	197
Peru	[r] 241,545	241,406	245,753
Europe:			
Albania[e][5]	6,970	[r] 7,690	8,540
Austria	2,539	2,991	2,962
Bulgaria	[r] 41,932	44,048	53,000
Czechoslovakia	5,180	6,600	6,600
Finland	32,121	41,192	39,850
France	520	456	432
Germany, East[e]	3,300	1,700	--
Germany, West[6]	1,456	1,583	1,911
Greece	1,715	1,587	[e] 3,300
Hungary[e]	1,300	[r] 1,300	1,300
Ireland	[r] 15,052	14,330	14,000
Italy[6]	1,156	946	1,183
Norway[6]	[r] 28,668	31,320	25,399
Poland	148,800	170,900	209,400
Portugal[6]	6,744	6,409	6,226
Romania[e][2]	38,600	46,300	55,100
Spain[6][7]	39,812	42,420	41,970
Sweden	33,752	49,404	44,597
U.S.S.R.[e][2][5]	733,000	772,000	816,000
United Kingdom	262	506	[e] 660
Yugoslavia	113,685	123,231	[e] 136,000
Africa:			
Algeria	[r] 406	389	551
Botswana	--	[e] 1,500	2,624
Congo (Brazzaville)[3]	1,511	1,022	1,025
Kenya	79	[e] 70	[e] 70
Mauritania	16,342	23,454	22,188
Morocco[3]	4,220	4,762	5,820
Mozambique[3]	198	441	689
Rhodesia, Southern[8]	42,218	46,100	[e] 44,400
South Africa, Republic of	178,494	193,783	197,730
South-West Africa, Territory of[3][9]	[r] 28,865	37,664	35,801
Uganda	17,346	17,259	13,900
Zaire	[r] 480,322	538,312	549,904
Zambia	791,128	778,864	769,364

See footnotes at end of table.

Table 43.—Copper: World mine production by country[1]—Continued

(Short tons)

Country	1972	1973	1974 [p]
Asia:			
Burma[10]	88	77	77
China, People's Republic of [e]	110,000	110,000	110,000
Cyprus[6]	[r] 18,195	18,841	12,739
India	12,856	16,085	21,605
Indonesia	5,500	41,800	72,140
Iran[11]	[r] 1,320	3,300	1,980
Israel	12,318	11,202	11,000
Japan[12]	123,584	100,619	90,538
Korea, North [e]	14,000	14,000	14,000
Korea, Republic of	2,295	2,558	3,080
Malaysia [e]	65	55	45
Philippines	235,558	243,825	248,554
Taiwan [e]	2,760	2,650	2,760
Turkey	[r] 24,339	39,700	42,765
Oceania:			
Australia	205,925	242,712	281,695
Fiji	3	--	--
New Zealand	136	[e] 110	--
Papua New Guinea	186,641	201,613	202,935
Total	[r] 7,321,950	7,848,266	8,104,695

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[e] Estimate. [p] Preliminary. [r] Revised.

[1] Data presented represent copper content (recoverable where indicated) of ore mined wherever possible. If such data are not available, the nonduplicative total copper content of ores, concentrates, matte, metal and/or other copper-bearing products measured at the least stage of processing for which data are available has been used.

[2] Recoverable.

[3] Copper content of concentrate produced.

[4] Corporación Minera de Bolivia (COMIBOL) production plus exports by medium and small mines.

[5] Smelter production.

[6] Includes copper content of cupriferous pyrites.

[7] Excludes an unreported quantity of copper in iron pyrites which may or may not be recovered.

[8] Year ending September 30 of that stated.

[9] Data are compiled from operating company reports of Tsumeb Corp. Ltd., General Mining and Finance Corp. Ltd. for Klein Aub Koper Maatskappy Ltd.'s mine near Rehoboth, and Falconbridge Nickel Mines Ltd. for Oamites Mining Company (Pty.) Ltd., Oamites mine. Data for General Mining and Finance Corp. Ltd. are for fiscal years ending June 30 of that stated, while data from other companies are for calendar years.

[10] Copper content of matte produced.

[11] Year beginning March 21 of that stated.

[12] Copper content of concentrate. Copper content of run-of-mine production was as follows in short tons: 1972—125,248; 1973—103,871; 1974—90,985.

Table 44.—Copper: World smelter production by country[1]

(Short tons)

Country	1972	1973	1974[p]
North America:			
Canada	522,200	545,641	591,990
Mexico[2]	81,831	80,506	86,822
United States[3]	1,690,391	1,748,963	1,569,816
South America:			
Argentina[e]	90	90	90
Brazil	5,290	4,630	3,860
Chile[4]	[r] 695,117	650,258	798,403
Peru	[r] 151,061	147,719	155,244
Europe:			
Albania[e]	6,970	7,694	8,543
Austria	1,433	330	[e] 330
Belgium[5]	14,300	17,600	[e] 17,600
Bulgaria	53,000	58,000	62,000
Czechoslovakia	[r] 7,700	7,700	6,600
Finland	38,751	45,836	48,569
Germany, East[e]	2,650	1,650	--
Germany, West	175,738	264,122	224,868
Hungary[e]	1,300	1,300	1,300
Norway[6]	[r] 36,339	36,690	34,574
Poland[7]	[r] 144,400	172,400	192,900
Portugal	4,189	4,400	4,400
Romania[e]	38,600	46,300	55,100
Spain	88,817	104,082	142,443
Sweden	40,836	48,875	45,125
U.S.S.R.[e]	788,000	772,000	816,000
Yugoslavia	164,296	174,628	[e] 179,900
Africa:			
Rhodesia, Southern[8]	45,277	[e] 46,000	[e] 48,500
South Africa, Republic of	[r] 184,970	165,790	162,920
South-West Africa, Territory of[9]	28,791	39,737	[10] 51,381
Uganda	15,618	10,684	9,810
Zaire[11]	[r] 472,010	507,591	529,100
Zambia	768,629	759,024	781,828
Asia:			
China, People's Republic of[e]	110,000	110,000	110,000
India	11,538	12,070	12,125
Iran[12]	[13] [r] 4,400	[e] 4,960	[e] 4,400
Japan	[r] 857,298	1,102,885	1,112,148
Korea, North[e]	14,000	14,000	14,000
Korea, Republic of	11,354	[e] 11,500	13,670
Taiwan[13]	3,860	3,970	4,400
Turkey	[r] 18,846	28,372	32,603
Oceania: Australia	[r] 160,211	178,815	215,610
Total	[r] 7,404,601	7,931,807	8,148,472

[e] Estimate. [p] Preliminary. [r] Revised.

[1] Unless otherwise noted, data presented for each country represented primary copper metal output, whether produced by thermal or electrowinning. To the extent possible, refined copper produced from imported blister or electrolytic anode copper has been excluded

[2] Copper content of impure bars and electrolytic copper.

[3] Smelter output of domestic and foreign ores, exclusive of that from scrap. Production from domestic ores only was as follows in short tons: 1972—1,649,130; 1973—1,705,065; and 1974—1,532,066.

[4] Figures presented are total blister and equivalent copper output including that blister subsequently refined in Chile and copper which is produced by electrowinning. Material produced for refining at Ventanas smelter is included.

[5] Belgium reports a large output of refined copper, but this is produced mainly from import blister; domestic smelter production is reported output of blister copper from ores.

[6] Reported Norwegian copper output is derived in part from copper-nickel matte imported from Canada, and reported Canadian smelter production may also include this material. Norwegian smelter output from domestic ores was as follows (approximately) in short tons: 1972—7,500; 1973—7,500; and 1974—6,500.

[7] Refined output.

[8] Year ending September 30 of that stated.

[9] Data are compiled from operating company reports of Tsumeb Corp. Ltd., General Mining and Finance Corp. Ltd. for Klein Aub Koper Maatskappy Ltd.'s mine near Rehoboth, and Falconbridge Nickel Mines Ltd. for Oamites Mining Company (Pty.) Ltd., Oamites mine. Data for General Mining and Finance Corp. Ltd. are for fiscal years ending June 30 of that stated, while data from other companies are for calendar years.

[10] Figure comprises reported production of Tsumeb Corp. Ltd. and Oamites Mining Company (Pty.) Ltd. plus an estimate for Klein Aub Koper Maatskappy Ltd.

[11] Data include refined copper plus exported blister and leach cathodes.

[12] Includes secondary.

[13] Year beginning March 21 of that stated.

Table 45.—Copper: World refinery production by country [1]

(Short tons)

Country	1972	1973	1974 [p]
North America:			
Canada [2]	546,685	548,489	616,329
Mexico	65,688	63,065	75,179
United States	1,873,233	1,868,488	1,654,658
South America:			
Argentina [e]	90	90	90
Brazil [2]	[r] 29,540	32,190	41,120
Chile [3]	[r] 508,606	457,238	593,153
Peru	43,225	42,964	42,990
Europe:			
Albania [e]	[r] 6,970	[r] 7,690	8,540
Austria	25,015	25,215	29,446
Belgium [4]	360,762	410,364	428,027
Bulgaria	[r] 49,600	52,900	57,300
Czechoslovakia [2]	19,917	20,390	19,800
Finland	42,355	47,297	42,193
France	17,196	[r] [e] 23,800	[e] 28,700
Germany, East [e]	44,000	[r] 46,300	50,700
Germany, West [2]	439,297	448,263	466,896
Hungary [e] [2]	19,000	19,000	19,000
Norway	[r] 29,158	28,446	27,433
Poland	[r] 144,400	172,400	192,900
Portugal	1,990	2,551	2,777
Romania [e]	38,600	46,300	55,100
Spain	[r] 108,455	113,516	[e] 133,000
Sweden	45,706	52,760	[e] 53,500
U.S.S.R. [e]	697,000	733,000	777,000
United Kingdom	[r] 65,675	83,619	76,165
Yugoslavia	141,769	147,312	154,038
Africa:			
Rhodesia, Southern [e] [5]	[r] 33,000	33,000	33,000
South Africa, Republic of	[r] 87,410	99,870	97,550
Zaire [6]	[r] 238,320	246,429	280,617
Zambia	678,165	703,835	746,103
Asia:			
China, People's Republic of [e]	120,000	130,000	130,000
India	[r] 11,400	13,200	12,987
Iran [e]	1,100	1,100	1,100
Japan	892,821	1,048,057	1,101,262
Korea, North [e]	14,000	14,000	14,000
Korea, Republic of [2]	9,988	10,192	13,668
Taiwan [2]	[r] 5,257	7,329	10,868
Turkey	[r] 18,916	19,800	34,300
Oceania: Australia	[r] 153,342	159,299	178,680
Total	[r] 7,627,651	7,979,758	8,300,169

[e] Estimate. [p] Preliminary. [r] Revised.

[1] Unless otherwise noted, data presented for each country represent total primary refined copper (both fire refined and electrolytically refined), including material refined from imported crude copper (blister and electrolytic anode).

[2] Includes secondary.

[3] Includes electrolytic output of the Ventanas refinery.

[4] Data include leach cathodes from Zaire, secondary, and alloy material.

[5] Year ending September 30 of that stated.

[6] Excludes metal content of leach cathodes which are included in Belgium production.

Diatomite

By Stanley K. Haines [1]

Domestic production of diatomite increased in 1974 for the third consecutive year. Diatomite sold or used by producers in the United States increased 9% in quantity and 40% in value compared with that of 1973. The United States remained a major world producer of processed diatomite. U.S. exports of processed diatomite increased in both quantity and value over those of 1973.

DOMESTIC PRODUCTION

All U.S. diatomite production was derived from open pit operations in California, Kansas, Nevada, Oregon, and Washington. California continued as the largest producing State.

During 1974, 11 companies, with a total of 17 mine or plant operations, mined and processed diatomite to supply the demand of various industrial end users. The following companies supplied the bulk of the processed diatomite production: Johns-Manville Products Corp., with a quarry and processing plant near Lompoc, Calif.; Grefco, Inc., with operations near Lompoc, Calif., and Mina, Nev.; Eagle-Picher Industries, Inc., with facilities near Sparks and Lovelock, Nev.; and Kenite Corp., Division of Whitco Chemical Corp., with an operation near Quincy, Wash. The remaining producers were Excel-Minerals Co., near Taft, Calif.; Airox Earth Resources, Inc., near Santa Maria, Calif.; NL Industries, Inc., near Wallace, Kans.; Fernley Division, Cyprus Mines Corp., near Fernley, Nev.; and A. M. Matlock and American Fossil, Inc., both near Christmas Valley, Oreg.

Eagle-Picher Industries, Inc., announced plans for a $5 million expansion of the company's diatomite filter aid facilities at Lovelock, Nev. Production capacity of the plant will be increased about 50% when the project is completed.

Table 1.—Diatomite sold or used by producers in the United States

	1970	1971	1972	1973	1974
Domestic production (sales) ---- short tons ----	597,636	535,318	576,089	608,906	664,303
Average value per ton ----------------------------	$54.63	$64.25	$65.19	$59.26	$76.31

CONSUMPTION AND USES

All major end uses reported gains in quantities consumed. Filtration continued as the major end use of diatomite accounting for three-fifths of domestic demand. Abrasives, industrial filters, and lightweight aggregates accounted for over one-fifth of demand. The remainder was consumed in miscellaneous uses such as pozzolan, inert carrier, and coating agent.

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[1] Geologist, Division of Nonmetallic Minerals.

Table 2.—Domestic consumption of diatomite, by principal use
(Percent of total consumption)

Use	1970	1971	1972	1973	1974
Filtration	58	59	58	61	60
Fillers	19	W	W	W	W
Insulation	4	3	4	4	5
Miscellaneous	19	38	38	35	35

W Withheld to avoid disclosing individual company confidential data; included with "Miscellaneous."

PRICES

The weighted average value per ton of diatomite, for all end uses in 1974, increased almost 29% over that of 1973. The increases were caused by a combination of general inflation and the higher cost for energy needed in processing the diatomite. Prices of diatomite used in filtration and as fillers increased 34% and 24%, respectively.

Table 3.—Average annual value per ton of diatomite, by use

Use	1973	1974
Filtration	$65.18	$87.40
Insulation	50.39	55.59
Abrasives	125.46	129.51
Fillers	62.01	77.12
Lightweight aggregate	45.02	47.31
Miscellaneous	36.99	46.25
Weighted average	59.26	76.31

FOREIGN TRADE

Exports of prepared diatomite increased 4% in quantity and 21% in value over those of 1973. Exports represented 28% of domestic production. Major countries of destination were Canada, 41,857 short tons; Japan, 19,896 tons; the United Kingdom, 16,667 tons; the Federal Republic of Germany, 14,587 tons; Australia, 12,585 tons; and the Republic of South Africa, 8,637 tons. The remainder was shipped to many other countries for various end uses. The average value of exported material was $94.31, and represented a 16% increase over that of 1973. Imports of diatomite totaled 3,690 tons, valued at $264,438. The primary source of imports was Mexico, minor quantities were received from Kenya and the United Kingdom.

Table 4.—U.S. exports of diatomite
(Thousand short tons and thousand dollars)

Year	Quantity	Value
1972	148	12,603
1973	178	14,582
1974	186	17,541

WORLD REVIEW

Preliminary 1974 data indicate an increase in production of over 86,000 short tons, a 5% increase over 1973 production. The United States continued to lead all other nations in production of diatomite.

Table 5.—Diatomite: World production, by country

(Short tons)

Country	1972	1973	1974 [p]
North America:			
Canada	[e] 500	--	--
Costa Rica	23,149	33,000	[e] 39,000
Mexico	10,006	21,560	22,000
United States	576,089	608,906	664,303
South America:			
Argentina	11,869	17,989	[e] 22,000
Colombia	394	386	[e] 400
Peru	3,483	[r] [e] 3,400	[e] 3,400
Europe:			
Austria	2,704	2,353	2,255
Denmark:			
Diatomite [e]	22,000	22,000	22,000
Moler [e]	240,000	240,000	240,000
France	217,263	[r] [e] 220,000	[e] 230,000
Germany, West (marketable)	[r] 63,905	50,144	[e] 49,000
Iceland	24,251	24,582	[e] 24,800
Italy [e]	65,000	65,000	65,000
Portugal	1,820	1,271	2,090
Spain	21,152	22,046	[e] 23,000
Sweden	--	489	[e] 500
U.S.S.R.[e]	420,000	430,000	440,000
United Kingdom	[r] 9,921	4,409	[e] 4,400
Africa:			
Algeria	5,031	[e] 5,100	[e] 5,100
Egypt, Arab Republic of	1,839	1,764	[e] 1,800
Kenya	1,997	137	[e] 110
South Africa, Republic of	346	582	870
Asia: Korea, Republic of	2,155	4,389	[e] 4,400
Oceania:			
Australia	[r] 1,694	5,314	[e] 5,500
New Zealand	5,507	4,962	[e] 4,400
Total	[r] 1,732,075	1,789,783	1,876,328

[e] Estimate. [p] Preliminary. [r] Revised.

Feldspar, Nepheline Syenite, and Aplite

By J. Robert Wells [1]

Feldspar production, processing, and utilization all scored advances in 1974, more than compensating for such negative factors as fading fuel supplies, multiplying health and safety regulations, and indirectly the high price of sugar.

Expenditures for more and more costly oil and natural gas (used by most major producers for drying flotation-cake feldspar) continued to mount in coincidence with the necessity for unprecedented outlays for labor, operating supplies, and all mining and processing equipment, whether new items or spare parts and replacements.

In common with most other mineral production and processing activities, the feldspar industry is subject to rules governing land use, mined-area reclamation, working conditions, and control of air and water pollution that are issued by the Federal Government, including the Environmental Protection Agency (EPA), the Interior Department's Mining Enforcement and Safety Administration (MESA), and the Labor Department's Occupational Safety and Health Administration (OSHA), as well as by some State and local authorities. It was reported that in 1974 substantial and increasing portions of the feldspar industry's operating funds and technical capabilities were being diverted from direct production-oriented considerations toward efforts to comply with those demands.[2] In early 1974, inadequate observation of industrial hygiene precautions led to a MESA ruling that temporarily suspended production of high-potash feldspar in South Dakota.

The relationship of high sugar prices to feldspar may not have been as direct or as easy to trace as that of government controls, but its effects were no less striking. Soaring sugar prices increased the cost of sugar-heavy bottled drinks and also induced a less explicable boost in the price of "sugar-free" dietetic varieties. These increases, coupled with rising prices for staple food items, made it relatively easy for the shopper to defer beverage purchases, thereby notably depressing soft drink sales in the last half of 1974.[3]

The manufacture of disposable beverage bottles, the next negative factor in line, had been outstandingly prosperous, with uninterrupted, conspicuous annual increases for as long as separate statistics have been published (since 1960), but the 1974 output of those convenient containers departed sharply from the trend and fell 4.4 million gross (or 7%) below the 1973 figure.[4] The makers of glass containers have been the foremost consumers of feldspar and related substances for many years, and the feldspar industry may well feel at least a few ripples in 1975 from the wave of shoppers bypassing the soft drink shelf in 1974.

Legislation and Government Programs.—According to provisions of the Tax Reform Act of 1969, which continued in force throughout 1974, the depletion rates allowed on feldspar production (both domestic and foreign operations) was 14%.

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[1] Physical scientist, Division of Nonmetallic Minerals.

[2] Rogers, C., Jr. Feldspar. Min. Eng., v. 27, No. 2, February 1975, pp. 75–76.

[3] Industry Week. Food Feels Consumer Resistance. V. 184, No. 12, Mar. 24, 1975, p. S–11.

[4] Bureau of the Census. Current Industrial Reports: Glass Containers—Summary for 1974. May 1975, 4 pp.

Table 1.—Salient feldspar statistics

	1970	1971	1972	1973	1974
United States:					
Unground:[1]					
Sold or used by producers short tons	726,069	742,810	r 746,212	791,900	853,702
Value thousands	$9,638	$9,969	r $10,633	$12,830	$14,482
Imports for consumption short tons	252	134	187	264	30
Value thousands	$23	$19	$23	$22	$1
Sold to consumers short tons	NA	NA	175,526	179,732	220,326
Value thousands	NA	NA	$1,257	$1,862	$2,903
Consumption, apparent[2] short tons	726,321	742,944	r 746,399	792,164	853,732
Ground:					
Sold by merchant mills short tons	647,995	601,618	580,801	588,698	612,858
Value thousands	$9,458	$8,716	$8,990	$10,628	$13,058
Exports short tons	5,570	3,984	5,275	9,554	18,319
Value thousands	$195	$141	$184	$466	$662
Imports for consumption short tons	3,637	2,375	945	103	62
Value thousands	$93	$65	$20	$4	$3
World production thousand short tons	2,786	2,815	r 2,994	r 2,993	3,174

r Revised. NA Not available.

[1] Includes hand-cobbed feldspar, flotation-concentrate feldspar, and feldspar in feldspar-silica mixtures.

[2] Measured by quantity sold or used plus imports.

FELDSPAR

DOMESTIC PRODUCTION

Unground Feldspar.—The 1974 output of feldspar ready to be put into final form for use was 8% more in quantity and 13% more in total value than in 1973. This output comprises hand-cobbed feldspar, flotation-concentrate feldspar, and the feldspar content of feldspar-silica mixtures, for which the collective term "unground feldspar" is perhaps somewhat less ambiguous than the former designation "crude feldspar."

Feldspar was mined in 1974 in nine States (one more than in 1973), among which North Carolina, Connecticut, Georgia, California, and South Dakota jointly supplied 98% of the national total; Arizona, Colorado, Oklahoma, and Wyoming made up the remainder.

There were a number of events in 1974 that affected the pattern of feldspar production in the United States. Sobin Chemicals, Inc., acquired International Minerals & Chemical Corp.'s feldspar producing and processing facilities near Spruce Pine, N.C., and continued to operate them under the name of Ceramics and Glass Products Division of Sobin Chemicals. Lithium Corporation of America, a subsidiary of Gulf Resources and Chemical Corp., secured title to the stock and properties of Spartan Minerals Co. at Pacolet, S.C. The newly formed Spartan Minerals Division of Lithium Corporation, will continue operation of the Pacolet plant, producing feldspar and other minerals from pegmatite ores that will be mined in North Carolina.

In that same region, Foote Mineral Co. announced the forthcoming construction of a large new facility at Kings Mountain, N.C., to produce lithium carbonate from spodumene extracted from pegmatites. Recovery of accessory minerals from Kings Mountain lithium ores has made Foote Mineral an important producer of feldspar.

In the roster of California feldspar producers, the late 1973 closing of Wedron Silica Co.'s Pacific Grove mine in Monterey County was balanced in June 1974 by the inauguration of the California Non-Metallic, Inc., mine and grinding plant at Santa Fe Springs to process feldspar from a deposit at Ord Mountain in San Bernardino County.

Table 2.—Unground feldspar sold or used by producers in the United States
(Thousand short tons and thousand dollars)

Year	Hand-cobbed		Flotation concentrate		Feldspar-silica mixtures[1]		Total[2]	
	Quantity	Value	Value	Quantity	Value	Quantity	Quantity	Value
1970	53	543	415	5,395	258	3,699	726	9,638
1971	45	749	443	5,454	255	3,766	743	9,969
1972	[r] 39	[r] 653	535	7,354	172	2,627	[r] 746	[r] 10,633
1973	53	636	546	9,789	193	2,406	792	12,830
1974	NA	NA	NA	NA	NA	NA	854	14,482

[r] Revised. NA Not available.
[1] Feldspar content.
[2] Data may not add to totals shown because of independent rounding.

Ground Feldspar.—Most of the feldspar used in glassmaking is ground no finer than 20 mesh, and substantial tonnages of feldspathic sands (feldspar-silica mixtures) enter into glass furnace feeds with no further reduction in particle size. Feldspar to be used in ceramics and filler applications is usually pulverized to minus 200 mesh or finer. Nine companies, operating 15 plants in 9 States, ground feldspar for market in 1974, supplying ground material (total tonnage 4% more than 1973) for shipment to destinations in about 25 States, Puerto Rico, Canada, and Mexico. Listed in descending order of output tonnages, North Carolina had six grinding mills, and Connecticut, Georgia, and South Carolina had one each. These were the leaders in ground feldspar production and jointly accounted for 92% of the 1974 total. South Dakota with two mills, followed by Arizona, California, Colorado, and Wyoming with one each, were the five States making up the remaining 8%. Oklahoma was the only feldspar-producing State in 1974 in which no grinding mill was in operation.

CONSUMPTION AND USES

Unground Feldspar.—In 1974 there was, as usual, no significant consumption of feldspar in the raw, unprocessed state in which it is taken from the mine; the majority of users acquired their supplies already ground and sized either by the primary producers or by merchant grinders. Some manufacturers of pottery, soaps, and enamels, however, continued their customary practice of purchasing crude feldspar for grinding to their preferred specifications in their own mills. The Bureau of Mines canvass of producers and merchant grinders does not provide information concerning the end-use distribution of the material handled in this way. It should be noted that a substantial portion of the material classified as feldspar-silica mixtures serves in glassmaking without the need for additional processing, so that this utilization might properly be considered as consumption of unground feldspar.

Ground Feldspar.—The 1974 distribution pattern for ground feldspar indicated in table 3 differs notably from that of 1973 especially in the figures reported for feldspar-silica mixtures. It is thought that the quantities shown in some previous years as being consumed for glass and pottery may have been reported in error because of a misunderstanding about the nature of the material properly classified as feldspar-silica mixtures. The intention has been to apply that term only to material consisting of feldspar and free quartz in approximately equal proportions. Most of the material falling into this category is either feldspathic sand or else a flotation product, neither of which usually requires any further grinding for the end uses they serve.

Table 3.—Ground feldspar sold by merchant mills, by use

Use	1973 Quantity (short tons)	1973 Value (thousands)	1974 Quantity (short tons)	1974 Value (thousands)
Hand-cobbed:				
Glass	--	--	100	$4
Pottery	36,860	$1,000	75,156	1,811
Other	17,258	502	15,479	513
Total	54,118	1,502	90,735	2,328
Flotation concentrate:				
Glass	217,267	3,302	216,968	3,593
Pottery	115,569	2,616	196,849	5,041
Other	11,512	249	30,501	859
Total	344,348	6,167	444,318	9,493
Feldspar-silica mixture: [1]				
Glass	91,897	1,179	--	--
Pottery	75,698	1,309	--	--
Other	22,637	471	77,805	1,237
Total	190,282	2,959	77,805	1,237
Total:				
Glass	309,164	4,481	217,068	3,597
Pottery	228,127	4,925	272,005	6,852
Other [2]	51,407	1,222	123,785	2,609
Total	588,698	10,628	612,858	13,058

[1] Feldspar content.
[2] Includes soaps, abrasives, refractories, and rubber.

STOCKS

From a comparison of 1974 data on domestic production and sales of feldspar, it was estimated that U.S. producers had 251,000 tons of feldspar (unground, ground, or in process) on hand on December 31, 1974.

PRICES

Engineering and Mining Journal, October through December 1974, listed the following prices for feldspar, per short ton, f.o.b. mine or mill, carload lots, bulk, depending on grade (generally $1 to $7.50 per ton higher than the respective quotations of the previous year):

North Carolina:	
20 mesh, flotation	$14.50–$15.50
40 mesh, flotation	14.00– 22.00
200 mesh, flotation	25.50– 29.00
Georgia:	
40 mesh, granular	26.00
200 mesh	31.00
Connecticut:	
20 mesh, granular	19.00
200 mesh	26.00

Feldspar prices were quoted by Industrial Minerals (London), December 1974, as follows (converted from pounds sterling per long ton to dollars per short ton):

Ceramic grade, powder, 200 mesh, bagged, ex-store	$80–$91
Sand, 2–3 millimeters, ceramic/glass grade c.i.f. main European port	31–40

FOREIGN TRADE

In 1974, U.S. exports classified as feldspar, leucite, nepheline, and nepheline syenite (but presumably all or mostly feldspar) amounted to 18,319 tons valued at $661,831, almost double the tonnage reported in 1973 and just under 1½ times the value. Chief recipients of the exported material were Canada, 84%; and Mexico, 13%; the remaining 3% was shared among nine other countries.

In marked contrast to rising exports of feldspar, U.S. imports of the mineral continued along the downward trend of recent years and amounted to only 0.5% of the tonnage exported, and 0.6% of the corresponding value. In addition to feldspar (table 4) and nepheline syenite (table 6), U.S. imports in 1974 included 2,931 tons of material, probably feldspathic in nature, that was classified as "Natural mineral fluxes, crude, crushed, ground, or pulverized" and had a total value of $262,145.

The tariff schedule in force throughout 1974 provided for a 3½% ad valorem duty on ground feldspar; imports of unground feldspar were admitted duty free.

Table 4.—U.S. imports for consumption of feldspar

Country	1973 Quantity (short tons)	1973 Value	1974 Quantity (short tons)	1974 Value
Unground:				
Canada	46	$3,725	30	$617
South Africa, Republic of	218	17,870	--	--
Total	264	21,595	30	617
Ground, crushed or pulverized:				
Canada	103	3,549	23	915
Sweden	--	--	39	2,533
Total	103	3,549	62	3,448

WORLD REVIEW

Canada.—Although the last feldspar mine in Canada (at Buckingham, Quebec) was closed down in 1972, two different organizations have continued exploring the possibility of producing feldspar in another Province. Centex, an association of industry, government, and university groups in Manitoba, had undertaken an assessment of the economics of recovering feldspar and other coproducts from tailing piles and waste dumps accumulated in the Province. Also in Manitoba, a private firm, Tantalum Mining Corporation of Canada Limited (Tanco), entered into a detailed study of by-product separation of marketable silica-feldspar mixtures from the currently discarded pegmatite-ore residues generated in the process of tantalum production.

Finland.—Finland's production of industrial minerals currently amounts to over 500,000 tons per year and of that total some 66,000 tons is feldspar, mostly high-potash microcline. The mineral is recovered by froth flotation from complex pegmatitic ores in mixtures with graphic granite at a new plant especially built for that purpose by Lojo Kalkverk AB, the European firm to employ that procedure in feldspar beneficiation.[5] An industrial journal published a detailed description of the equipment, flowsheets, and operating procedures in use at the alkverk mines and mill, which are situated on the island of Kimito (or Kemio) off Finland's southwest coast in the Gulf of Bothnia.[6]

Guyana.—Bauxite has been for many years the foremost source of Guyana's mineral export revenue, but recently there has been a notable upsurge of interest in the nation's known but almost entirely unexploited industrial minerals. The existence in Guyana of large deposits of high-grade kaolin, talc, kyanite, and silica sand has suggested the advantages of developing domestic glass and ceramics industries, either or both of which would offer an attractive outlet for feldspar, another of the industrial minerals occurring in commercial quantities within the national boundaries.[7]

India.—An industrial association published an updated version of an earlier report that, while emphasizing the mining industry of India and presenting a register of names and addresses of that nation's mineral producers, also outlined the international situation of 17 important industrial minerals—one of which was feldspar—with regard to world occurrences, production, reserves, and export/import trade.[8]

Jordan.—According to Mr. Nimri of the Jordanian Natural Resources Authority, Geological Research and Mining Department, even though phosphate rock is the only industrial mineral at present contributing to the national economy, at least five others including feldspar also exist in commercially exploitable quantities. Mr. Nimri further stated that a U.S. firm, Swindell-Dressler Co., has been authorized to conduct a study of the possibility of producing feldspar in Jordan for export to other Arab countries for use in glassmaking.

Sweden.—The Statsgruvor, the Swedish national mining authority, began a study to delineate the commercial possibilities of a large deposit of feldspar recently discovered in central Sweden by a private prospector. The potentially valuable ore body lies near the surface at Hällsjön, between Örebro and Motala, and may prove to be the largest occurrence of glass- and ceramic-grade feldspar in the country.

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[5] Saikkonen, R. Finland's Industrial Minerals and Their Growing Markets. Ind. Miner. (London), No. 81, June 1974, p. 28.

[6] Ironman, R. Froth Flotation Yields Feldspar Concentrate. Rock Products, v. 77, No. 2, February 1974, pp. 58–60, 84.

[7] Industrial Minerals (London). Guyana: Thar's Industrial Minerals in Them Thar Hills! No. 81, June 1974, p. 63.

[8] Federation of Indian Mineral Industries. Export Possibilities of Minor Minerals. New Delhi, India.

United Kingdom.—In terms of value, 1973 was a record year for the United Kingdom's foreign trade in nonmetallic minerals, with imports as usual far ahead of exports. Imports of feldspathic materials included 140,000 tons of feldspar, principally from Norway, Finland, Sweden, and Portugal with a total value of approximately $2.35 million, and 54,000 tons of nepheline syenite from Norway and Canada valued at $1.7 million. Exports consisted of 5,900 tons of feldspar valued at $0.26 million.

Domestic production ("China stone," "Cornwall stone") amounts to less than 3% of the United Kingdom's annual requirements for feldspathic materials, so that understandably a lively interest was aroused by the discovery a few years ago of a possible source of usable-grade feldspar in northwest Scotland.[9] The subsequent investigation, however, although confirming or increasing earlier estimates of the quantities of feldspar existing in the Durness pegmatite, raised serious doubts concerning the quality of the product that could be obtained—specifically, the iron content of the material was found to be excessive, and efforts to bring it down to an acceptable level were not successful. Increasing inability of domestic producers to supply even a modest part of the ceramic industry's feldspathic needs has now prompted a reexamination of the Durness material, with the tentative conclusion that at least a marginally satisfactory feldspar-quartz mixture can be prepared from it by a dry process involving high-intensity magnetic separation. A campaign was started for the purpose of accumulating a 500-ton test lot of such a product for industry evaluation.[10]

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[9] Mining Magazine (London). Feldspar in Scotland. V. 126, No. 2, February 1972, p. 133.

[10] Wright, A. J., and E. T. Daniell. Durness Feldspar: An Economic Prospect in the Highlands of Scotland? Ind. Miner. (London), No. 81, June 1974, pp. 9, 13.

Table 5.—Feldspar: World production by country

(Short tons)

Country[1]	1972	1973	1974 ^{p}
North America:			
Canada (shipments)	11,684	--	--
Mexico	108,426	107,042	^{e} 110,000
United States	^{r} 746,212	791,900	853,702
South America:			
Argentina	70,801	33,532	^{e} 39,000
Brazil	74,266	81,692	^{e} 88,000
Chile	^{r} 2,421	584	3,093
Colombia	29,055	33,069	^{e} 33,100
Peru	2,129	^{e} 2,200	^{e} 2,200
Uruguay	1,070	226	1,937
Europe:			
Austria	3,391	2,260	--
Finland	65,982	64,285	^{e} 66,000
France	^{r} 249,119	^{e} 245,000	^{e} 230,000
Germany, West	385,198	392,192	^{e} 400,000
Italy	^{r} 201,521	209,657	^{e} 257,000
Norway[2]	244,378	^{e} 248,000	^{e} 248,000
Poland ^{e}	33,000	33,000	33,000
Portugal	19,854	22,920	30,937
Spain[3]	^{r} 69,431	71,650	^{e} 77,000
Sweden	37,579	30,815	^{e} 31,000
U.S.S.R. ^{e}	287,000	300,000	320,000
United Kingdom (china stone)	58,422	53,809	^{e} 55,000
Yugoslavia	53,280	56,005	^{e} 56,000
Africa:			
Egypt, Arab Republic of	3,565	3,343	^{e} 3,800
Kenya	2,163	1,610	^{e} 1,650
Malagasy Republic[4]	17	63	11
Mozambique	^{r} 325	915	^{e} 1,000
Nigeria	^{r} 4,754	^{e} 5,500	^{e} 5,500
South Africa, Republic of	27,913	34,934	43,585
Zambia	--	13	1,777

See footnotes at end of table.

Table 5.—Feldspar: World production by country—Continued
(Short tons)

Country[1]	1972	1973	1974[p]
Asia:			
Burma	[r] 1,008	343	728
Hong Kong	1,267	1,477	6,135
India	[r] 58,203	43,872	[e] 44,000
Japan[5]	[r] 68,712	56,766	68,718
Korea, Republic of	[r] 16,192	31,372	[e] 33,000
Pakistan	[r] 338	1,314	3,699
Philippines	50,774	27,556	[e] 22,000
Sri Lanka	638	689	[e] 700
Oceania: Australia	[r] 3,454	3,160	[e] 3,200
Total	[r] 2,993,542	2,992,765	3,174,472

[e] Estimate. [p] Preliminary. [r] Revised.

[1] In addition to the countries listed, the People's Republic of China, Czechoslovakia, Romania, and the Territory of South-West Africa produce feldspar, but available information is inadequate to make reliable estimates of output levels.

[2] Described in source as lump feldspar; does not include nepheline syenite as follows, in short tons: 1972—177,542; 1973—220,793; 1974—224,430.

[3] Includes pegmatite.

[4] Chiefly labradorite.

[5] In addition, the following quantities of aplite and saba were produced: Aplite: 1972—501,069; 1973—547,665; 1974—539,670; Saba: 1972—1,336; 1973—NA; 1974—NA.

TECHNOLOGY

The 1974 research program of the Bureau of Mines included investigations of possibilities for improving the froth-flotation recovery of microcline feldspar (College Park Metallurgy Research Center, College Park, Md.) and for the recovery of potash feldspar from sulfide mill tailings (Tuscaloosa Metallurgy Research Laboratory, Tuscaloosa, Ala.). A Bureau report was published describing a system devised for obtaining feldspar in a usable form from a residue generated in the production of crushed stone and currently being discarded.[11]

An important modification of quarrying techniques was put into practice by some of the principal feldspar producers in 1973–74. The innovation emphasized the use of low-cost blasting materials of the ammonium nitrate, fuel oil type (AN-FO) in water-gel form and, in some cases, necessitated the purchase of heavier drilling machinery to make larger diameter blast holes to accommodate bulkier charges of those explosives.[12]

Most of the flotation schemes currently in use by feldspar producers involve conditioning the mineral with hydrofluoric acid prior to floating. Hydrofluoric acid, in addition to being expensive and hazardous, gives rise to pollution-control problems. The notable solubility of nearly all fluorides and fluosilicates generated during conditioning, makes it difficult or impossible to remove them from flotation-plant effluents that otherwise could conveniently be discharged into nearby watercourses. A patent was issued for a flotation method in which the customary addition of hydrofluoric acid is avoided by applying a mixture of beef-tallow amine acetate and an aromatic sulfonate to separate and collect feldspar from a pulp acidified to pH 2.0 to 3.5 with sulfuric acid.[13]

An increase of more than 40% in production capacity was achieved at two large feldspar-grinding plants in South Dakota without the installation of additional milling units. This remarkable improvement, along with important cost reductions for power, mill accessories, and maintenance, was credited to the replacement of the flint pebbles formerly serving as the grinding medium by rods consisting of a special preparation of dense and fine-grained crystalline alumina. As a further benefit, this innovation effectively circumvented the objectionable contamination of the product with silica that had resulted from the attrition of the natural pebbles.[14]

Preparation of frits for porcelain enamel provides a large outlet for high-quality feldspar, usually in the range of 10,000 to 30,000 tons per year in the United States. A journal article described the closely monitored operations carried out in the enameling plant of a major manufacturer of large household appliances.[15]

A patent was granted for a glassmaking

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[11] Eddy, W. H., E. W. Collins, and G. V. Sullivan. Recovery of Feldspar and Glass Sand From Georgia Waste Granite Fines. BuMines RI 7928 1974, 11 pp.

[12] Work cited in footnote 2.

[13] Katayanagi, A. Froth Flotation Beneficiation of Feldspar. U.S. Pat. 3,844,939, Oct. 29, 1974.

[14] Rock Products. Change in Grinding Media Ups Feldspar Output. V. 77, No. 12, December 1974, p. 37.

[15] Jordan, R. E., Jr. Top Porcelain Enameling Techniques, Loyalty and Dedication of Work Force Are Winning Combination for Whirlpool. Ceram. Age, v. 90, No. 4, April 1974, pp. 6–9.

procedure in which the raw materials—silica, limestone, soda ash, and feldspar—are mixed and dampened with sodium hydroxide solution, briquetted, preheated with glass-furnace combustion gases, and then melted by a submerged-combustion procedure. It was claimed that in this manner there are achieved worthwhile reductions in fuel consumption and in capital costs of melting equipment, together with a substantial lowering of atmospheric pollution by sodium sulfate in the vented flue gases.[16]

In a process for which two patents were issued, aluminum is produced in the metallic state from iron-containing feldspar or other aluminous ores by chlorinating at over 700° C in the presence of a carbonaceous reductant to form gaseous aluminum monochloride, which upon subsequent flash cooling to 700° C disproportionates to yield metallic aluminum and aluminum trichloride. The aluminum metal is removed, and the still-hot gaseous aluminum trichloride is recycled to the original chlorination step.[17]

Speedy, precise, and repeatable analytical methods were described for analyzing high-silica and high-aluminosilicate materials, such as feldspar. These new methods bear little resemblance to the cook-book procedures, which were used by analysts many years ago.[18]

At least three important additions to the literature of feldspar became available in 1974, two dealing specifically with the feldspar minerals[19] and the other devoted to the closely related subject of the feldspathoids.[20]

NEPHELINE SYENITE

Nepheline syenite, a rock of igneous origin with a texture similar to that of granite, consists essentially of mixtures of nephelite with varying proportions of the alkali feldspars. Nepheline syenite found thus far in the United States has been of a quality suitable only for use as crushed stone. Canada, however, has an immense deposit at Blue Mountain, Ontario, from which two firms, Indusmin Limited, and International Minerals & Chemical Corp. (Canada) Limited, mine high-grade material that serves advantageously as an alumina-bearing ingredient in furnace feeds for glassmaking, as either a body component or a fluxing agent for ceramics, and increasingly in recent years as a filler for plastics, latex articles, paints, and paper.

In 1973, the last year for which estimates are available, Canadian production of nepheline syenite totaled approximately 576,000 tons with a value of $7.4 million. In 1974, Indusmin, already the larger of the two Canadian producers, announced plans for a major expansion of its Nephton mining and milling facilities that will provide substantially greater production capacity.

Other than Canada, only two countries are known to produce significant quantities of nepheline syenite—Norway with 177,500 tons in 1972 and 221,000 tons in 1973, and the U.S.S.R. where, although production figures are not released, the mineral is known to serve the customary applications of the glass and ceramics industries and also as a major source of cell-feed alumina for electrolytic aluminum plants.

U.S. imports of Canadian nepheline syenite, which were first reported in the mid-1930's, have increased in all but a few of the years since and now appear to be rising sharply. Starting at 10,000 tons per year or less in 1936, the figure reached 100,000 tons per year by 1955, 200,000 tons per year by 1964, 300,000 tons per year by 1968, 400,000 tons per year by 1971, and went beyond 500,000 tons per year in 1974. Under the present U.S. tariff schedule, imports of nepheline syenite, ground or unground, are admitted duty free.

The price range quoted for imported nepheline syenite in Ceramic Industry Magazine, January 1975, was from $11.75 to $31.45 per ton, depending upon grade, purity, grind, packaging, transportation, quantity of sales, and other factors. Price ranges for this commodity listed in Industrial Minerals (London), December 1974, were equivalent (with a minor degree of uncertainty because of the floating sterling/dollar exchange rate) to the following:

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[16] Nesbitt, J. K., and M. E. Fejer (assigned to Institute of Gas Technology). Process For Pre-Treating and Melting Glassmaking Materials. U.S. Pat. 3,788,832, Jan. 29, 1974.

[17] Othmer, D. F. Method for Producing Aluminum Metal Directly From Ore. U.S. Pats. 3,793,003, Feb. 19, 1974, and 3,853,541, Dec. 10, 1974.

[18] Bennett, H. Trends in Ceramic Analysis. Ceram. Age, v. 90, No. 4, April 1974, pp. 14–16.

[19] Smith, J. V., and B. F. Smith. Feldspar Minerals. V. 1. Crystal Structure and Physical Properties. Springer-Verlag, New York, 1974, 628 pp.

——————. Feldspar Minerals. V. 2. Chemical and Textural Properties. Springer-Verlag, New York, 1974, 690 pp.

MacKenzie, W. S., and J. Zussman (ed.). The Feldspars (proceedings of a NATO Advanced Study Institute, Manchester, England, July 11–12, 1972). Crane Russak & Co., Inc., New York, 1974, 717 pp.

[20] Sorensen, H. (ed.). The Alkaline Rocks. John Wiley & Sons, Inc., New York, 1974, 622 pp.

Canadian, bagged, ex-store:	
Glass grade, 30-mesh, 10-ton lots	$45–$81
Ceramic grade, 200- or 325-mesh, small lots	63– 71
Norwegian, ex-store:	
Glass grade, 32-mesh (Tyler), bulk	38
Ceramic grade, 325-mesh (Tyler), bagged	54

Table 6.—U.S. imports for consumption of nepheline syenite

Year	Unground		Ground	
	Quantity (short tons)	Value (thousands)	Quantity (short tons)	Value (thousands)
1972	3,027	$48	456,406	$5,681
1973	258	4	473,838	6,022
1974	4,605	79	505,028	7,558

APLITE

Aplite is a fine-grained granitic rock containing quartz mixed with varying proportions of soda, lime-soda, or potash feldspars, any or all of which make it potentially useful as a raw material for manufacturing container glass. However, to be made acceptable for that purpose, the material occurring in most deposits must first be processed to eliminate most of the iron-bearing substances it usually contains. Japan with about 500,000 tons annually, is the world's foremost producer of aplite.

Aplite of glassmaking quality was produced in the United States in 1974 from two open pit mines in central Virginia. The Feldspar Corp. mined aplite ore near Montpelier, Hanover County, and removed iron from it by an electrostatic process. Sobin Chemicals, Inc. operated a mine near Piney River, Nelson County, and subjected the crushed aplite to a high-intensity magnetic separation to eliminate iron minerals.

Specific annual data on domestic aplite production, sales, and value have not been released for publication since 1962, when the output amounted to 140,000 tons, valued at $0.9 million. Domestic production reached an alltime high in 1974, but the corresponding total value was notably lower than in 1973.

The price range for aplite given in Ceramic Industry Magazine, January 1974, was from $12.70 to $13 per ton, but no quotation for aplite appeared in the January 1975 issue.

Ferroalloys

By Norman A. Matthews [1]

The overall structure of the domestic ferroalloy industry remained unchanged during 1974. Demand continued at capacity levels throughout most of the year. Ferromanganese capacity was reduced temporarily. New furnaces for silicon alloys went into operation and, together with reduced demand for silicon in cast iron and cast aluminum, eased the shortages of silicon alloys that had persisted during most of 1973. Ownership of two plants changed hands during the year, and construction was started on a completely new plant for silicon alloys in Alabama. Expansion projects were initiated for manganese alloys in West Virginia and ferrochromium silicon alloy in New York.

Ferroalloy exports declined, whereas imports continued to increase. Value of imports rose 83% as prices increased substantially during the year.

With the removal of price controls, a general increase in domestic prices occurred in late March, another in the third quarter, and another late in the year. In general prices doubled during the year, reflecting recovery from price controls and increased raw material and power costs.

Detailed information concerning utilization of individual elements in various alloy products can be found in the chromium, manganese, silicon, molybdenum, nickel, tungsten, and vanadium chapters.

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[1] Physical scientist, Division of Ferrous Metals.

Table 1.—Government inventory of ferroalloys (stockpile grade), December 31, 1974
(Thousand short tons)

Alloy	National (strategic) stockpile	CCC and supplemental stockpile	Total
Ferrochromium:			
High-carbon	126	276	402
Low-carbon	128	191	319
Ferrochromium-silicon	26	32	58
Ferrocolumbium (contained columbium)	0.5	--	0.5
Ferromanganese:			
High-carbon	129	533	662
Medium-carbon	29	--	29
Ferromanganese-silicon	23	--	23
Ferromolybdenum (contained molybdenum)	0.4	--	0.4
Ferrotungsten (contained tungsten)	1	--	1
Ferrovanadium (contained vanadium)	0.6	--	0.6

Table 2.—Ferroalloys produced and shipped from furnaces in the United States

	1973				1974			
	Production		Shipments		Production		Shipments	
	Gross weight (short tons)	Alloy element contained (average percent)	Gross weight (short tons)	Value (thousands)	Gross weight (short tons)	Alloy element contained (average percent)	Gross weight (short tons)	Value (thousands)
Ferromanganese [1]	683,075	78.8	779,459	$136,907	544,361	78.0	573,877	$162,082
Silicomanganese	183,702	66.3	195,956	39,439	196,140	65.2	192,181	57,014
Ferrosilicon [2]	1,012,807	53.2	1,062,829	258,120	905,247	56.8	922,965	346,321
Chromium alloys:								
Ferrochromium:								
High-carbon	241,667	66.8	261,624	73,055	230,037	66.9	226,728	92,284
Low-carbon	88,085	69.4	104,329	45,988	87,263	72.4	93,111	71,096
Ferrochromium-Silicon	80,788	36.8	89,799	26,743	124,344	38.5	126,295	61,680
Other alloys [3]	16,306	43.9	16,816	10,788	3,016	99.0	3,105	6,497
Total	426,846	60.8	472,568	156,574	444,660	60.3	449,239	231,557
Ferrophosphorus	129,646	16.5	143,257	7,681	106,486	19.5	133,185	9,061
Ferrocolumbium	1,167	64.1	2,758	15,316	1,174	65.0	1,279	7,899
Other [4]	82,712	39.0	98,975	106,505	67,942	41.3	68,710	111,617
Grand total	2,519,955	60.0	2,755,802	720,542	2,266,010	61.1	2,341,436	925,551

[1] Includes briquets and fused-salt electrolytic.

[2] Includes silicon metal, silvery iron, and inoculant type alloys; does not include silicon alloys consumed internally.

[3] Includes chromium briquets, chromium metal, exothermic chromium additives, and other miscellaneous chromium alloys.

[4] Includes ferroboron, and other complex boron additive alloys, ferronickel, ferrotitanium, ferromolybdenum, ferrotungsten, ferrovanadium, spiegeleisen, ferrozirconium, and other miscellaneous alloys.

DOMESTIC PRODUCTION

The number of ferroalloy producers increased by 1 to 27, at yearend when Woodward Iron Co. of Mead Corp. sold its two plants; the Woodward, Ala., plant was acquired by Alabama Alloy Co., Inc., whereas the Rockwood, Tenn., plant was sold to Phillipp Brothers, Division of Englehard Minerals and Chemical Corp. A listing of producers, plant locations, products, and processes utilized is shown in table 3. Six producers specialized solely in ferrophosphorus as a byproduct of phosphorus production.

Demand for ferroalloys continued at high levels throughout most of 1974, but declined near yearend as inventories approached normal levels and steel and aluminum production rates declined. Overall production of 146 million tons of raw steel and 16.6 million tons of cast iron represented 4% and 8% declines, respectively, from the record tonnages in 1973, and demand for manganese and silicon alloys was reduced proportionately. Silicon demand was further reduced by the slack demand for aluminum castings from the dominant automotive and appliance markets. Manganese alloy supply was disturbed by conversion of two small blast furnaces to pig iron production, but shortages were minimized by substantial shipments from the Government stockpile. In contrast record production of stainless steel required record quantities of chromium, nickel, and molybdenum and, as a result, local shortages existed in some product forms, particularly in the second quarter. In retrospect there is substantial evidence that excess purchases were made by many firms, creating artificial shortages.

Several expansion projects were announced during the year. The most significant was the new ferroalloy plant to be built by Ohio Ferro-Alloy Corp. at Montgomery, Ala. This was the first ferroalloy plant to be built in the United States in 21 years. At an estimated cost of $20 million, and a capacity of 35,000 tons of silicon metal annually, the plant will consist of three furnaces for silicon metal and/or ferrosilicon, with the first furnace operational in late 1975. Of the total cost, $6 million represents the projected cost of pollution abatement equipment. Diamond Shamrock Corp. announced a $5 to $6 million expansion program to double capacity of bulk manganese to 17,000 tons annually, at the Chemetals Division plant in Kingwood, W. Va. Operation was projected for late 1975. Airco, Inc., announced a $15 million program at Niagara Falls to provide a second furnace of 36 kilowatt-ampere transformer rating and an additional 20,000 tons of capacity annually of ferrochromium silicon alloy by late 1976. The program includes rehabilitation of existing furnaces and provision of pollution abatement equipment.

Union Carbide Corp. announced development of a new tungsten mine and concentrator near Alamo, Nev., at a projected cost of $21 million. This will reduce U.S. dependence on imports from 60% to approximately 40%. The annual output rate of the mine will be second only to that of the Pine Creek, Calif., facility, to which the concentrates will be shipped for conversion to ammonium paratungstate. The new Tempiute mine and concentrator will process approximately 1,000 tons of ore per day.

Table 3.—Producers of ferroalloys in the United States in 1974

Producer	Plant location	Product[1]	Type of furnace
Airco Alloys and Carbide (Division of Airco, Inc.)	Calvert City, Ky Charleston, S.C Mobile, Ala Niagara Falls, N.Y	FeCr, FeCrSi, FeMn, FeSi, SiMn.	Electric.
Bethlehem Steel Corp	Johnstown, Pa	FeMn	Blast.
Chromium Mining & Smelting Co	Woodstock, Tenn	FeCr, FeSi, FeCrSi	Electric.
Climax Molybdenum Co. (Division of Amax, Inc.)	Langeloth, Pa	FeMo	Alumino-thermic.
Diamond Shamrock Corp	Kingwood, W.Va.	Mn	Electric.
Foote Mineral Company	Cambridge, Ohio Graham, W.Va Keokuk, Iowa Vancoram, Ohio Wenatchee, Wash	FeB, FeCb, FeTi, FeV, FeSi, silvery iron, other[2]	Do.
Hanna Nickel Smelting Co	Riddle, Oreg	FeNi	Do.
Interlake Steel Corp	Beverly, Ohio Selma, Ala	FeCr, FeCrSi, FeSi, SiMn.	Do.
Kawecki Berylco Industries, Inc	Springfield, Oreg	Si	Do.
Kawecki Chemical Co	Easton, Pa	FeCb	Alumino-thermic.
Molybdenum Corp. of America	Washington, Pa	FeMo, FeW, FeCb, FeB.	Electric and alumino-thermic.
New Jersey Zinc Co	Palmerton, Pa	Spln	Electric.
Ohio Ferro-Alloys Corp	Brilliant, Ohio Philo, Ohio Powhatan, Ohio	FeCr, FeSi, FeB, FeMn, SiMn, other[2]	Do.
Reading Alloys	Robesonia, Pa	FeCb, FeV	Alumino-thermic.
Shieldalloy Corp	Newfield, N.J	FeV, FeTi, FeB, FeCb, NiCb, CrMo, other[2]	Do.
Tennessee Alloys Corp	Bridgeport, Ala Kimball, Tenn	FeSi	Electric.
Tenn-Tex Alloy Corp. of Houston	Houston, Tex	FeMn, SiMn	Do.
Union Carbide Corp	Alloy, W.Va Ashtabula, Ohio Marietta, Ohio Niagara Falls, N.Y Portland, Oreg Sheffield, Ala	FeB, FeCr, FeCrSi, FeCb, FeSi, FeMn, FeTi, FeW, FeV, SiMn, other[2]	Do.
United States Steel Corp	McKeesport & Clairton, Pa.	FeMn	Blast.
Woodward Iron Co	Woodward, Ala Rockwood, Tenn	FeSi, FeMn, SiMn	Electric.
Ferrophosphorus:			
FMC Corporation	Pocatello, Idaho	FeP	Do.

See footnotes at end of table.

Table 3.—Producers of ferroalloys in the United States in 1974—Continued

Producer	Plant location	Product [1]	Type of furnace
Hooker Chemicals & Plastics Corp.	Columbia, Tenn	FeP	Electric
Mobil Chemical Co	Nichols, Fla	FeP	Do.
Monsanto Chemical Ltd	Columbia, Tenn Soda Springs, Idaho	FeP	Do.
Stauffer Chemical Co	Tarpon Springs, Fla Mt. Pleasant, Tenn Silver Bow, Mont	FeP	Do.
Tennessee Valley Authority	Muscle Shoals, Ala	FeP	Do.

[1] CrMo, Chromium molybdenum; FeMn, ferromanganese; Spln, spiegeleisen; SiMi, silicomanganese; FeSi, ferrosilicon; FeP, ferrophosphorous; FeCr, ferrochromium; FeMo, ferromolybdenum; FeNi, ferronickel; FeTi, ferrotitanium; FeW, ferrotungsten; FeV, ferrovanadium; FeB, ferroboron; FeCb, ferrocolumbium; NiCb, nickel columbium; Si, silicon metal.

[2] Includes zirconium alloys, ferrosilicon magnesium, calcium silicon, and miscellaneous ferroalloys.

CONSUMPTION AND USES

Steel production of 146 million tons involved a reported consumption of 1,168,860 tons of ferromanganese of all types, essentially equal to consumption in 1973 when a record steel production of 150.8 million tons was achieved. Steel product mix is gradually changing with larger volumes in the high-strength low-alloy (HSLA) types which, almost universally, are higher in manganese. However, it appears that the efficiency of manganese recovery is gradually deteriorating and is undoubtedly influenced by basic oxygen furnace practices which probably do not achieve a fully reduced slag condition prior to final manganese additions. Silicomanganese consumption was also higher in 1974 than in 1973.

Silicon alloy consumption totaling 987,902 tons in 1974 declined considerably from that consumed in 1973, and correlated more closely with the approximate 14% and 20% decline respectively, in cast iron and cast aluminum production. The ferrotitanium figure for 1974 is substantially lower than that reported for 1973; the 1973 consumption figure was overstated and should have been 5,143 tons. Corrected distribution of ferrotitanium usage in 1973 reduced the carbon steel category to 981 tons, the alloys category to 1,166 tons, and other uses category to 142 tons. Ferrotitanium usage continues to grow as would be expected with growth of high-strength low-alloy steel tonnages.

Consumption of ferrochromium, ferronickel, and ferromolybdenum was at record levels correlating with record production of stainless and tool steels. Similarly the increase in consumption of ferrovanadium and ferrocolumbium reflects continued growth in shipments of high-strength low-alloy steels. Vanadium and tungsten consumption for tool steels, in the ferroalloy form, declined in 1974 compared with that of 1973. Nickel consumption as ferronickel continued to increase rapidly as world supply increased.

Table 4.—Consumption by end use of ferroalloys as additives in the United States in 1974

(Short tons of alloys)

Alloy	Stainless steels	Other alloy steels	Carbon steels	Tool steels	Cast irons	Superalloys	Alloys (excludes alloy steels and superalloys)	Other uses [1]	Total
Ferromanganese [2]	21,304	226,189	865,562	2,762	27,241	817	21,630	3,355	1,168,860
Silicomanganese	12,648	44,103	100,750	16	10,677	90	3,645	5,242	177,166
Silicon alloys [3]	37,167	99,514	187,839	3,408	524,494	585	81,693	53,202	987,902
Ferrotitanium [4]	2,386	969	1,065	W	108	779	2,080	34	7,421
Ferrophosphorus [5]	25	1,551	12,924	W	5,705	--	820	76	20,601
Ferroboron	11	260	30	--	22	W	71	2	396
Total	73,536	372,586	1,168,170	6,186	568,247	2,271	109,439	61,911	2,362,346

W Withheld to avoid disclosing individual company confidential data; included in "Other uses."

[1] Includes unspecified uses.

[2] Includes spiegeleisen, manganese metal, and briquets.

[3] Includes silicon metal, silvery iron, and inoculant alloys.

[4] Includes other forms such as scrap titanium metal.

[5] Includes other phosphorus materials.

Table 5.—Consumption by end use of ferroalloys as alloying elements in the United States in 1974

(Short tons of contained elements)

Alloy	Stainless steels	Other alloy steels	Carbon steels	Tool steels	Cast irons	Super alloys	Alloys (excludes alloy steels and superalloys)	Other uses [1]	Total
Ferrochromium [2]	265,710	58,185	2,606	4,872	7,163	11,987	5,348	4,069	359,940
Ferromolybdenum [3]	1,064	1,283	238	606	1,814	332	401	88	5,826
Ferrotungsten [4]	71	123	--	701	--	64	47	2	1,008
Ferrovanadium [5]	88	4,182	787	936	47	50	28	8	6,076
Ferrocolumbium	256	883	506	10	W	474	16	40	2,185
Ferronickel	36,519	6,963	--	--	417	590	1,171	3	45,663
Total	303,658	71,619	4,137	7,125	9,441	13,497	7,011	4,210	420,698

W Withheld to avoid disclosing individual company confidential data; included in "Other uses."

[1] Includes unspecified uses.

[2] Includes other chromium ferroalloys and chromium metal.

[3] Includes calcium molybdate but not molybdenum oxide.

[4] Includes melting base self-reducing tungsten.

[5] Includes other vanadium-carbon-iron ferroalloys.

STOCKS

Producers' stocks declined overall during 1974 and were particularly low in manganese and chromium alloys at yearend. Consumer stocks of manganese and chromium alloys had recovered to a normal level by yearend, whereas consumer stocks of silicon alloys were much higher than normal. Ferronickel consumer stocks also increased substantially during the year.

Table 6.—Stocks of ferroalloys held by producers and consumers in the United States, December 31, 1974

(Short tons)

	Producer		Consumer	
	1973 (gross weight)	1974 (gross weight)	1973 (gross weight)	1974 (gross weight)
Managanese ferroalloys [1]	122,098	84,873	180,242	298,048
Silicon alloys [2]	41,800	57,495	145,413	184,075
Ferrochromium [3]	37,690	20,512	48,456	53,747
Ferrotitanium [4]	W	W	r 3,622	2,911
Ferrophosphorus [5]	52,325	26,431	5,536	6,385
Ferroboron	286	61	91	205
Total	r 254,199	189,372	r 383,360	540,371
	1973 (contained element)	1974 (contained element)	1973 (contained element)	1974 (contained element)
Ferromolybdenum [6]	W	W	1,105	1,190
Ferronickel	W	W	7,792	11,514
Ferrotungsten	W	W	170	245
Ferrovanadium	271	304	1,135	1,732
Ferrocolumbium	340	463	728	860
Total	611	767	10,930	15,541

r Revised. W Withheld to avoid disclosing individual company confidential data.

[1] Includes ferromanganese, silicomanganese, spiegeleisen, and manganese metal.

[2] Includes ferrosilicon, silvery iron, silicon metal, and miscellaneous silicon alloys.

[3] Includes other chromium ferroalloys and chromium metal.

[4] Includes other titanium materials.

[5] Includes other phosphorus materials.

[6] Includes calcium molybdate.

PRICES

Prices of all ferroalloys increased several times during the year, with the initial round of increases following price decontrol late in March. In general manganese alloy prices increased in late March, in the second quarter of the year, and in December. Chromium and silicon alloy prices increased in late March, in the third quarter of the year, and in December. In general terms, prices doubled during 1974 as the following illustrates:

Alloy and units [1]	Price, year-end 1973	Price, year-end 1974
Standard 78% ferromanganese, dollars per gross ton	200	400–440
Low-carbon ferromanganese, 0.05% maximum carbon	32.5	59.5
Charge chromium (64% to 69%)	20.0	50–53
Low-carbon ferrochromium, 0.05% maximum carbon	33.0	83
Ferrosilicon, 75%	22.35	36.5–38.5
Silicon metal, 1% maximum iron	23–26	40–55
Ferronickel	138	197
Ferrovanadium	419	555

[1] Cents per pound contained unless otherwise indicated; prices as quoted in American Metal Market.

Price increases were attributed to rising costs during the period of price controls, and 1974 cost increases for ore and other raw materials, power, and labor. Perhaps of greatest importance was the expressed necessity of improving profits to generate capital for expansion and modernization of facilities.

FOREIGN TRADE

Quantity of U.S. exports of ferroalloys in 1974 declined 45% compared with that of 1973, but value increased to $37.6 million as much higher unit prices applied universally. Canada and Japan remained the largest export customers. Most of the decline was in chromium and silicon alloys and ferrophosphorus. Only ferromolybdenum exports showed a substantial increase when compared with that of 1973. The overall quantity exported in 1974 was 46,168 tons.

In general, imports continued to increase during 1974 and reached a total of 945,593 tons valued at $388.6 million, representing a 17% increase in tonnage and an 83% increase in value compared with 1973 totals. The largest tonnage increases were recorded for high-carbon ferromanganese, ferrosilicon manganese, and 75% ferrosilicon. The largest percentage increases in imports occurred in some of the smaller volume items such as low-carbon ferromanganese and ferrotitanium. Imports of ferronickel also increased substantially and the value thereof was the highest of any single commodity. A new category, entitled Base Metal Alloys, Unwrought, was added to table 8. This category, for 1974, predominantly reflects imports of silicon metal of 94% to 97% silicon.

The Republic of South Africa remained the dominant exporter of ferroalloys to the United States in 1974, principally manganese and chromium alloys, totaling 209,000 tons, followed by France with 195,000 tons, Norway with 74,348 tons, Japan with 65,481 tons, Yugoslavia with 42,491 tons, Sweden with 35,065 tons, and Brazil with 19,703 tons. In the case of 75% ferrosilicon, 25 countries were listed as countries of origin; high-carbon ferromanganese, the largest tonnage commodity, was imported from 13 countries, but 6 countries accounted for 96% of the tonnage imported.

In chromium alloys, shipments to the United States ranked by value were from: (1) the Republic of South Africa; (2) Yugoslavia; (3) Southern Rhodesia; and

(4) Japan. In manganese alloys, receipts were from: (1) France; (2) the Republic of South Africa; (3) Japan; and (4) Norway. The value of silicon alloys imported almost tripled to $72 million, whereas the tonnage increased by 47% compared with 1973 figures. In silicon alloys, imports by value were from: (1) Norway; (2) Yugoslavia; (3) France; and (4) Sweden.

Prices of ferroalloys throughout the market economies of the world increased rapidly during 1974. Prices of imported alloys also increased rapidly in parallel with domestic prices. In general, import prices (not including transportation) were lower than domestic prices throughout the year. The exception was 50% ferrosilicon alloy. For this alloy average import prices, not including transportation, exceeded domestic prices throughout the year.

Table 7.—U.S. exports of ferroalloys

Alloy	1972		1973		1974	
	Quantity (short tons)	Value (thousand dollars)	Quantity (short tons)	Value (thousand dollars)	Quantity (short tons)	Value (thousand dollars)
Ferrocerium and alloys	101	610	55	286	96	503
Ferrochromium	12,861	4,342	15,164	5,091	7,245	3,764
Ferromanganese	6,842	1,512	8,574	2,187	7,011	2,204
Ferromolybdenum	454	1,163	1,112	3,151	2,047	7,094
Ferrophosphorus	1,179	111	19,030	778	3,677	408
Ferrosilicon	7,367	2,196	15,984	4,051	6,575	3,338
Ferrotungsten	11	85	6	50	10	215
Ferrovanadium	269	1,256	1,416	8,784	1,335	7,863
Ferroalloys, n.e.c	15,557	8,495	22,828	9,485	18,172	12,186
Total	44,641	19,770	83,669	33,758	46,168	37,575

Table 8.—U.S. imports for consumption of ferroalloys and ferroalloy metals

Alloy	1973			1974		
	Gross weight (short tons)	Content (short tons)	Value (thousand dollars)	Gross weight (short tons)	Content (short tons)	Value (thousand dollars)
Chromium metal	2,690	(1)	6,080	1,959	(1)	5,397
Ferrocerium and other cerium alloys	19	(1)	127	26	(1)	303
Ferrochromium:						
Containing 3% or more carbon	112,197	69,584	18,253	116,156	71,317	33,132
Containing less than 3% carbon	43,344	30,224	16,922	45,411	30,762	22,124
Ferromanganese:						
Containing less than 1% carbon	1,939	1,595	810	4,163	3,494	1,660
Containing over 1% and less than 4% carbon	46,243	37,496	10,919	42,827	34,804	15,468
Containing 4% or more carbon	342,185	264,776	41,579	384,224	289,575	71,292
Ferronickel	89,780	25,700	70,532	102,430	33,425	115,649
Ferrosilicon:						
8% to 60% silicon	23,979	7,257	3,657	28,762	8,480	6,269
60% to 80% silicon	75,519	55,750	17,364	112,556	83,616	59,305
80% to 90% silicon	396	343	47	289	243	164
Over 90% silicon	39	38	19	624	587	611
Ferrosilicon-chromium	13,037	(1)	3,127	7,549	(1)	2,044
Ferrosilicon-manganese (Mn content)	44,759	30,061	6,367	67,752	44,718	20,684
Ferrotitanium and ferrosilicon titanium	256	(1)	178	2,296	(1)	3,123
Ferrotungsten and ferrosilicon tungsten	696	553	3,105	505	404	3,029
Ferrovanadium	277	196	1,174	216	139	1,120
Ferrozirconium	1,249	(1)	627	818	(1)	553
Ferroalloys n.e.c.[2]	2,246	(1)	6,719	2,445	(1)	7,161
Manganese metal	2,452	(1)	1,100	2,505	(1)	1,376
Silicon metal (less than 99.7% silicon)	7,939	7,588	3,509	5,508	5,422	5,810
Base metal alloys[3]	--	--	--	16,577	(1)	12,341
Total	811,241	XX	212,215	945,598	XX	388,565

XX Not applicable.

[1] Not recorded.

[2] Principally ferrocolumbium.

[3] Principally silicon metal of 94% to 97% silicon.

WORLD REVIEW

Table 9 lists ferroalloy production in the world by country and furnace type for the years 1972 through 1974 from the most reliable sources. Production increased overall as the steel companies of the world operated generally at capacity levels, at least through October. The total world production, reported and estimated, of 12.4 million tons in 1974 represents a 4.7% increase over that produced in 1973. Countries which showed substantial increases in production in 1974 included: West Germany (blast furnace alloys), Canada, Brazil, Norway, Yugoslavia, the Republic of South Africa, and Japan.

Australia.—Tasmanian Electro Metallurgical Co. Pty. Ltd., a subsidiary of Broken Hill Proprietary Co. Ltd., announced an expansion at Bell Bay, Tasmania to double capacity to 160,000 tons annually with two new furnaces, one each for ferromanganese and ferrosilicon. The new installations, including an ore processing facility, were estimated to cost $29 million, with startup scheduled for late 1975. Hydroelectric power will be provided from the Pieman Power Project.

Consolidated Gold Fields Ltd., with two other Australian partners and the Norwegian Ferro Silicon Producers' Association (Fesil), announced a new ferrosilicon plant to be constructed at Electrona near Hobart, Tasmania. Two furnaces were planned, the first for ferrosilicon production at an annual rate of 50,000 tons for operation in 1976 and the second producing silicon metal and scheduled for operation in 1977. The products will be exported, principally to Japan.

Brazil.—Brejui Mineração Metalurgia announced that a ferrotungsten plant of 200 tons annual capacity would be constructed by 1976, after a pilot plant campaign to be completed in early 1975. The plant will convert scheelite concentrates of 70% WO_3 content produced by the partner company Mineração Tomaz Salustino. One half of production is scheduled for export to Japan.

Cia. Brasileira de Mineração de Cáleio in Minas Gerais started up a 13.5 megavolt ampere furnace producing ferrosilicon at yearend. Several other Brazilian ferrosilicon producers have also announced expansions totaling 100,000 tons annually by 1979. These include Alumínio do Brasil S.A. 12,000 tons by 1978; Cia. de Ferro-Ligas da Bahia, S.A. 16,000 tons by 1976; Ligas de Alumínio S.A. 19,000 tons by 1976; Cia. Paulista de Ferro-Ligas, 7,000 tons by 1976; Eletrosiderúrgica Brasileira S.A. 23,000 tons by 1976; and Industria e Comercia, 16,000 tons by 1978.

Canada.—SKW Electro-Metallurgy Canada, Ltd., a subsidiary of Suddeutsche Kalkstickstoff-Werke A.G. of West Germany, announced contracts for a $40 million ferroalloy plant to be constructed in Becancour, Quebec. The plant, with 120 megawatt capacity, is designed for a combined capacity of 52,000 tons annually of ferrosilicon and silicon metal. Operation was scheduled for early 1976. Eighty percent of the output will be exported to Europe and the United States.

Northwest Mining Co., a subsidiary of Climax Molybdenum of Canada, delineated a large scheelite ore deposit in the Yukon Territory. The deposit, near the Northwest Territories border at MacMillan Pass, has reserves of at least 30 million pounds of tungsten. A large annual output is projected within 10 years.

Gabon.—The Gabonese Ferroalloy Co. (SOGAFERRO) was established in 1974. Interest in the company is held by the Government of Gabon (10%), Gabonese mining companies (30%), Japanese companies (25%), and the remainder by various French, Norwegian, Belgian, and Italian organizations. The Government has contracted with an international consortium (Belgian, French, West German, Dutch, Italian, and Spanish) to build a 410-mile railroad from the iron ore deposits at Mekambo to the ports of Libreville and Franceville at a cost of $325 million, with completion projected in 1981. Ferromanganese production is not anticipated prior to 1980.

Japan.—Japan produced 2,499,000 short tons (2,267,000 metric tons) of ferroalloys in 1974, exceeding the volume produced in the United States. Japan exceeded the United States in the production of ferromanganese, ferrochromium, ferronickel, silicomanganese, and ferrotungsten. Several expansion or replacement projects were announced during 1974. Nippon Refining and Concentrating Co. announced a new 30 megavolt-ampere furnace at Kohma with a capacity of 16,000 tons of ferrosilicon annually for operation in early 1976 at a cost of $2 million. Low power costs are expected from a captive powerplant. Japan Metals and Chemicals Co., Ltd., announced the addition of two 25 megavolt-ampere ferrosilicon furnaces at the Matsukawa plant, with a total capacity of 34,000 tons annually. The first was to be in operation late in 1975 and the second in 1976. Electrical energy will be supplied from an enlarged geothermal powerplant. Ube Denki Kaguku, a subsidiary of Ube Industries and Nissho-Iwai, planned to expand ferrosilicon production from 25,000 to 55,000 tons annually with installation of a 30 megavolt-ampere furnace by late 1975.

Norway.—Elkem-Spigerverket A/S planned a fourth ferrosilicon furnace at the Salten plant with a 35 megavolt-ampere transformer capability and a capacity of 30,000 tons annually, for operation in 1976. Cost was estimated at $21.5 million. It is understood that this furnace, and perhaps a second at the Halsland location, constitute the last expansions of ferroalloy capacity in Norway compatible with the overall allocation of energy to ferroalloys among the high electrical energy-consumption industries.

Philippines.—Maria Cristina Chemical Industries, the existing ferroalloy producer, announced an expansion at the Iligan site on Mindanao. The new furnace, with a capacity of 17,000 tons of ferromanganese annually, will be completed in late 1975 at a cost of $4.7 million. Nippon Denko Co. and C. Itoh & Co. of Japan formed a joint venture with the Laurel Foundation of the Philippines for a ferrosilicon plant, also at Iligan. The company which was established by the joint venture, Electro Alloys Corp., planned to operate one furnace initially, starting in 1976, with an annual capacity of 10,000 tons. Total production will be exported to Japan.

South Africa, Republic of.—Parliament passed new tax incentives for ore beneficiation and conversion, including production of ferroalloys. Extra investment allowances of 20% for machinery and 15% for buildings were incorporated into the law. Feralloys Ltd., the ferroalloys subsidiary of Associated Manganese Mines of S.A. Ltd., announced a $15 million expansion project for an additional manganese furnace at the Cato Ridge plant and a charge ferrochromium furnace at the Machadodrop plant at Fairview in the eastern Transvaal. The new furnaces will raise annual manganese and chromium alloy capacities by 50,000 and 30,000 tons, respectively, when in full operation in 1976.

Turkey.—Etibank, the state investment company, planned to install two 17 megavolt-ampere Japanese furnaces for high-carbon ferrochromium with production to start in 1976. Ore will be supplied locally from the Mardin area and power will be from the Kaban dam, completion of which has been delayed.

U.S.S.R.—The Government sought tenders in September from the United States and Europe for equipment and technology to produce 1,200,000 tons of ferromanganese, 320,000 tons of ferrochromium, and 60,000 tons of polycrystalline silicon annually. Associated were mining facilities for 2,300,000 tons of manganese ore concentrate and 2,150,000 tons of chromium ore concentrate annually. U.S. ferroalloy producers have been involved in detailed studies on some or all of the facilities required.

Upper Volta.—Eleven Japanese ferroalloy producers and trading firms, of which the principals were Japanese Metal Corp., Mitsui Corp., and Nippon Denko KK, together with Union Carbide Corp., French Society Manganese, and the German Exploration and Bergwerke, announced plans to develop the manganese ore deposits at Tambao. Shipments of 625,000 tons annually are anticipated by 1980 with over 50% alloted to the Japanese partners.

Venezuela.—Hevensa announced expansion of its ferrosilicon plant from 30,000 to 50,000 tons annually with completion in 1977. The project includes upgrading of existing facilities. Venbozel, a joint venture of the Government's Corporacíon Venezolana de Guyana and Nobel Bozel S.A. of France, began construction during the year of a 52 megavolt-ampere ferrosilicon furnace and plant structure in the Orinoco region. Completion of the first furnace is now projected for 1977 with a second furnace to follow in 1978. A third furnace, involving a joint venture with Nissho-Iwai and Mitsubishi Corp. of Japan, is also planned. Power will be provided from hydroelectric facilities in Guyana.

Table 9.—Ferroalloys: World production by country[1] and furnace type

(Thousand short tons)

Country	1972	1973	1974 [p]
BLAST FURNACE[2]			
Europe:			
Belgium	136	122	128
Czechoslovakia	31	[e] 33	[e] 33
Denmark	[r] 5	--	--
France	[r] 512	600	588
Germany, West[3]	347	405	483
Hungary	23	20	[e] 22
Italy	53	72	83
Poland	146	142	[e] 149
Portugal	9	[e] 11	[e] 11
U.S.S.R	[r] [e] 1,100	1,098	[e] 1,092
United Kingdom	[r] 168	176	97
Africa:			
South Africa, Republic of	76	64	--
Asia:			
Korea, Republic of[4]	18	29	38
Thailand[4]	--	--	9
ELECTRIC FURNACE[5]			
North America:			
Canada[2]	251	221	273
Mexico	85	90	[e] 94
United States[2]	2,527	2,520	2,257
South America:			
Argentina	47	[r] [e] 46	[e] 46
Brazil	[r] 154	188	239
Chile	15	[e] 15	[e] 15
Europe:			
Austria	6	6	[e] 6
Bulgaria	49	49	50
Czechoslovakia	128	134	140
Finland	27	44	53
France	391	489	508
Germany, West	240	292	312
Hungary	11	11	[e] 11
Italy	188	191	191
Norway	704	793	971
Poland	193	172	[e] 172
Portugal	--	5	12
Spain[6]	193	265	293
Sweden	[r] 263	249	[e] 250
Switzerland[e]	23	23	28
Yugoslavia	144	170	209
Africa:			
South Africa, Republic of	[r] 461	548	702
Asia:			
India	217	195	210
Japan	1,921	2,243	2,499
Taiwan	[r] 12	15	30
Turkey[e]	10	10	10
Oceania:			
Australia[2] [7]	[r] 94	[r] [e] 100	[e] 100
Total	[r] 10,978	11,856	12,409

[e] Estimate. [p] Preliminary. [r] Revised.

[1] In addition to the countries listed, the People's Republic of China and North Korea are known to produce ferroalloys, but output of these materials are included in estimates for pig iron in the iron and steel chapter, therefore they have been omitted here to avoid duplication. East Germany also is known to produce ferroalloys, but it is not clear from source publications whether output has been included together with that of pig iron and steel. Also Colombia, Greece, Luxembourg, Peru, Venezuela and Southern Rhodesia may produce ferroalloys and output, if any, is included with pig iron in the iron and steel chapter.

[2] Blast furnace ferroalloy production by Australia, Canada and the United States included under electric furnace output.

[3] Blast furnace ferromanganese, ferrosilicon and spiegeleisen only; other blast furnace ferroalloys are included in the pig iron production table in the iron and steel chapter.

[4] Includes electric furnace ferroalloys, if any are produced.

[5] In addition to the countries listed, the United Kingdom and the U.S.S.R. are known to have produced electric furnace ferroalloys and Romania may have produced some electric furnace ferroalloys, but output is not reported and no basis for estimation is available.

[6] May include small quantities of blast furnace ferroalloys, if any are produced.

[7] Year ended November 30 of year stated.

Yugoslavia.—Financing has been arranged for a $300 million ferronickel project based upon lateritic ores in the Kavadarci area of Macedonia. Arthur G. McKee Co. prepared the proposals which contemplate 16,000 tons of nickel in 60,000 tons of ferronickel annually with coproduction of 600,000 tons of iron concentrates. The ore deposits total 110 million tons of which 2.2 million tons will be processed annually. Feni Kombinat is the Yugoslavian company involved and has projected initial production in 1979.

TECHNOLOGY

The most active areas of research in iron and steel production that influenced the consumption of ferroalloys or the types of ferroalloys required were: (1) high-strength, nonheat-treated steels with emphasis on maximum toughness and/or ductility; (2) desulfurization of molten pig iron by magnesium or other additives; (3) desulfurization of cupola iron in the production of ductile (nodular) iron; and (4) new powder metallurgy processes. The evolution of optimum practices for HSLA steels continued with the most prominent fields of application principally Arctic gas pipelines and automotive uses. For such steels the unique properties are conferred by columbium and/or vanadium, rare-earth elements that influence inclusion morphology, and titanium. Demands on process technology include very low phosphorus and sulfur levels, minimum inclusion content, and controlled finish rolling temperatures.

In the United States and Western Europe considerable experimentation was in progress on the use of magnesium and other additives for desulfurizing molten blast furnace iron. Battelle Memorial Institute established a multisponsor program involving 14 U.S., European, Japanese, and Brazilian steel companies. Similarly, the use of magnesium wire injection for nodularizing cast iron received widespread attention as a result of a summary paper presented at the 1975 American Foundrymen's Society annual casting congress.[2]

United States Steel Corp. announced the newly patented "loose-pack" powder metallurgy process which involves: (1) vibratory packing of prealloyed powders in a mold; (2) sintering; and (3) hot forging to achieve near-theoretical density.[3] A disposable mold, constituted from paper, is used, and the process avoids the high costs of powder metallurgy presses. Of significance to ferroalloy interests is the likelihood that such a process, utilizing prealloyed powders, will alleviate the necessity of producing small quantities of special additive alloys in powder form.

Methods of pretreating the charge materials for submerged-arc furnace smelting continued to be studied. Representatives of Showa Denko K.K. of Japan presented a paper at the First International Ferro-Alloys Congress (INFACON '74) on pelletizing of the chromite ore feed for the production of charge chromium. Considerable improvements in furnace operability and productivity and a decrease in power consumption were reported. U.S. patent 3,847,114 was issued to the same company in November.

A journal article reported beneficial effects from high phosphorus in cast iron in reducing cleaning costs attributed to core and mold penetrations by the molten cast iron. Raising phosphorus levels from 0.03% to 0.09% reduced cleaning costs 35% to 40% on test castings simulating actual typical castings.[4]

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[2] Ashton, M.C., R. K. Durhr, J. G. Magny, and K. G. Davis. The Use of Magnesium Wire Injection for Production of Nodular Iron. American Foundrymen's Society Transactions, v. 83, 1975, pp. 51-54.

[3] Iron Age. Loose-Pack Cuts Hot Forging Preform Cost. V. 215, No. 23, June 9, 1975, pp. 53-55.

[4] Levelink, H. G. and Julien, F. P. M. A. Penetration and Shrinkage by Interaction of Solidifying Cast Iron and the Casting Mold. Cast Metals Research Journal, v. 9, Issues 2 (pp. 56-63) and 3 (pp. 64-75), November 1973.

A project at the Rolla Metallurgy Research Center of the Bureau of Mines evaluated methods for reclaiming metallics from electric furnace flue dusts, mill scale, and grinding swarf.[5] Pelletizing the dusts from a stainless steel production mill with a reducing agent and melting in an induction furnace formed an alloy containing 10% to 20% chromium, 6% to 12% nickel, and 55% to 65% iron, plus lesser amounts of manganese and molybdenum. Similarly pelletizing of such materials and feeding to a small submerged-arc furnace would be expected to improve recoveries; with proper temperature control significant reduction of silicon probably could be avoided.

The INFACON '74 was held in Johannesburg, South Africa, in April 1974 and was attended by 300 delegates from 22 countries. Thirty-two papers were presented under categories designated as burden preparation, specific processes, electric smelting furnaces, fundamental aspects, pollution control, and application and trends. The complete proceedings, including discussion, comprise the most comprehensive recent reference on trends in ferroalloy technology.[6]

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[5] Powell, H. E., W. M. Dressel, and R. L. Crosby. Experimental Metals Reclamation Process Recovers Alloys from Steel Mill Wastes. 33 Magazine, v. 13, No. 4, April 1975, pp. 48-50.

[6] South African Institute of Mining and Metallurgy. Proceedings First International Ferroalloys Congress. Johannesburg, South Africa, April 1974, 309 pp.

Fluorspar

By H. B. Wood [1]

The United States continued to rely on imports to supply about 88% of its reported demand for fluorspar. About 70% of reported demand was supplied by imports from Mexico. Domestic production decreased 19% from 1973 to 201,000 tons. U.S. reported consumption increased 13% from 1973, and apparent consumption decreased 6%. Consumers inventories increased 31%, to 431,000 tons of both acid-grade fluorspar (acid-spar) and metallurgical-grade fluorspar (met-spar). No sales were made from U.S. government inventories which remained at 1.3 million tons of combined acid-spar and met-spar. During 1974, U.S. imports of all grades of fluorspar increased 10% to 1,336,000 tons, synthetic and natural cryolite imports remained the same at about 20,000 tons, and imports of 70% hydrofluoric acid (HF) increased 3% to 32,500 tons.

Prices increases ranging from 5% to 9% were reported for various grades of fluorspar. All increases were predominantly the result of inflationary pressures, since there was no shortage throughout the world, and no cartel was known to be controlling prices.

Effective April 1, 1974, Pennwalt Corp. increased its interest in Ozark-Mahoning Co. from 35% to 100%. This made Pennwalt, which is a major importer of fluorspar and a manufacturer of hydrofluoric acid, the largest producer of fluorspar in the United States.

The Trade Act of 1974 became effective at yearend. This act authorized the President of the United States to enter into trade agreements with foreign countries, whereby the duties on imported materials could be eliminated or reduced by 60%. Fluorspar is one of the commodities subject to the provisions of the act. The effect of this act will not be known until sometime in 1975 or 1976.

In the Sweetwater District southwest of Knoxville, Tenn., U.S. Borax and Chemical Co. announced the discovery of about 50 million tons of fluorspar ore assaying 15% to 30% CaF_2.

Consumption of met-spar by iron and steel companies increased from 45% to 47% of the U.S. total, and the consumption of acid-spar to make hydrofluoric acid for use by the chemical and aluminum industries decreased from 52% to 51%.

In September, scientists predicted great danger to man's health if the escape of chlorofluorocarbons from aerosol sprays and refrigerants into the atmosphere was allowed to continue. Temporary and complete bans on the use of chlorofluorocarbons were proposed by State and Federal legislative representatives resulting in an immediate reduction in the demand for acid-spar, which was used to make hydrofluoric acid for manufacturing fluorocarbons.

Mexico, the world's largest producer of fluorspar, continued to supply the largest portion of U.S. imports, 74% in 1973 and 80% in 1974; Spain and Italy supplied most of the remainder. The largest fluorspar importing countries were the United States, Japan, the U.S.S.R., West Germany, and Canada. The largest exporting countries, in order of shipping volume, were Mexico, Thailand, Mongolia, Spain, the People's Republic of China and the Republic of South Africa. World production was about the same in 1974 as in 1973, and was only 2% greater than it was in 1972.

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[1] Geologist, Division of Nonmetallic Minerals.

Table 1.—Salient fluorspar statistics

	1970	1971	1972	1973	1974
United States:					
Production:					
Mine production -- short tons --	627,212	815,046	710,668	561,149	447,253
Material beneficiated -- do ----	698,232	758,169	771,411	668,861	409,005
Material recovered ---- do ----	252,128	247,250	245,047	232,891	207,816
Finished (shipments) - do ----	269,221	272,071	250,347	248,601	201,116
Value f.o.b. mine thousands --	$13,928	$17,263	$17,315	r $17,881	$14,297
Exports ------------ short tons --	14,952	12,491	2,764	2,428	5,847
Value ---------- thousands --	$1,145	$525	$184	$171	$316
Imports for consumption short tons --	1,092,318	1,072,405	1,181,533	1,212,347	1,336,889
Value f.o.b. foreign port thousands --	$32,758	$34,580	$47,851	$52,620	$60,988
Consumption (reported) short tons --	1,372,404	1,344,742	1,352,149	1,351,705	1,524,532
Consumption (apparent) [1] - do ----	1,217,311	1,314,972	1,487,983	1,508,759	1,428,719
Stocks Dec. 31:					
Domestic mines:					
Crude ------------ do ----	51,471	165,610	111,565	57,901	44,196
Finished ---------- do ----	12,370	28,259	15,294	8,675	13,668
Consumer ------------ do ----	419,746	486,759	377,942	327,703	430,642
World: Production ----------- do ----	4,620,469	r 5,243,644	r 4,992,406	r 5,043,787	5,082,263

r Revised.

[1] Apparent consumption includes finished shipments, plus imports, minus exports, and plus or minus stockpile adjustments.

Legislation and Government Programs.—The "omnibus bill" (OMB No. 5) that was submitted to the U.S. Congress in April 1973 had not, at yearend 1974, resulted in the sale of any of the General Services Administration (GSA) stockpile of fluorspar. The U.S. Office of Emergency Preparedness established a stockpile objective of 159,000 tons of met-spar, and presented a plan to dispose of 1,142,800 tons of excess met-spar and acid-spar combined. Any further action on this bill does not appear imminent because in January 1975, the Joint Congressional Committee on Defense, which is responsible for reviewing programs authorized by the Defense Production Act, advised against the sale of strategic materials from government stockpiles.

Title 1, of the Trade Act of 1974 that was signed in December, authorized the President for a period of 5 years, to enter into trade agreements whereby import duties could be reduced or eliminated. The duty on acid-grade fluorspar could be eliminated and the duty on metallurgical-grade fluorspar could be reduced 60%. Under Title 5, Generalized System of Preferences, the President was authorized to suspend the import duty on fluorspar for the most-favored, less-developed countries; but after hearings were held, fluorspar was eliminated from the list of eligible minerals under this act.

The Government, through the Office of Minerals Exploration, normally can grant loans up to 50% of approved costs for exploration of eligible deposits of fluorspar, but in Fiscal Year 1975 the administrating agency, the U.S. Geological Survey, was not allocated funds for this program.

Fluorspar was subject to a Federal depletion allowance of 22% domestic and 14% foreign.

U.S. fluorspar-import duties effective through 1974 were as follows:

Item	Number	Rate of Duty		Statutory rate per long ton
		Long ton	Short ton	
Acid-grade (+97% CaF_2) -	522.21	$2.10	$1.87	$5.60
Metallurgical-grade (−97% CaF_2) ---------	522.24	8.40	7.50	8.40

DOMESTIC PRODUCTION

During 1974, U.S. shipments of finished fluorspar decreased 19% to 201,000 tons. About 38% was acid-spar and 62% was met-spar, which included gravel-spar, ceramic-spar, and briquets. About 76% of the production was in Illinois, mainly in Pope and Hardin Counties. The rest was shipped from mines in Montana, Texas, Nevada, Kentucky, Utah, Colorado, and New Mexico, in order of volume.

During 1974, 23 mines and 9 flotation and heavy-media plants operated, but only 4 plants operated full time. Two mines were closed during the year, one in New Mexico and the other in Utah. Effective April 1, Pennwalt Corp. purchased full ownership of Ozark-Mahoning Co.; Pennwalt previously owned 35% of the company. As a result of the merger, Ozark was assigned management of all mining operations including Pennwalt's fluorspar-briquetting plant at Brownsville, Tex., and its La Consantina fluorspar mine in San Luis Potosí, Mexico. At Cowdrey, Colo., Ozark-Mahoning Co. shipped ore from inventory but did not operate its mines or flotation plant. In New Mexico, Mining and Milling Co. of America placed its new flotation plant, located south of Hachita, on standby basis while the firm explored for more ore at the Volcano mine.

In Kentucky, Cerro Spar Corp. went onstream in April with its new 55,000-ton-per-year output capacity froth flotation plant located near Salem. For the remainder of the year, the plant was operated on a part-time basis as development of the Babb-Barnes mine continued. This newly developed ore deposit occurs at depths of 300 to 700 feet. The operation was controlled by a joint venture; 70% owned by Cerro Spar Corp., a wholly-owned subsidiary of Cerro Corp., and 30% by Frontier Resources Inc., Denver, Colo., and J. Fred Landers, Nashville, Tenn. In Kentucky, Minerva Oil Co. reopened the Wheatcroft, Tabb, and Brown-Ward shafts to the Lafayette ore body and started limited production.

In Texas, mining operations were continued by D & F Minerals Co. in the Christmas Mountains on the north edge of Big Bend National Park. In Utah, Willden Fluorspar Co., Spor Brothers, and U.S. Energy Corp. continued small shipments. In Nevada, J. Irving Crowell, Jr., & Son and Spor Brothers, near Beatty, Nev., continued shipments—Crowell to a steel company and Spor Brothers to a cement company. Bailey Fluorspar Co. continued to operate buying stations at Marathon, Tex., and Delta, Utah, where they purchased custom ore and screened and graded it for the met-spar market.

In Illinois, both Ozark-Mahoning and Minerva Oil carried on a continuous exploration and development drilling program, thereby enabling development of sufficient reserves to replace annual production. Minerva continued to develop the Spivey mine, but it was not expected to be in full production until 1975. A shaft was being sunk to 685 feet and the planned depth of the main station was about 600 feet. The ore will be trucked about 10 miles to the Minerva flotation plant at Cave-in-Rock, Ill.

U.S. Borax and Chemical Co., a subsidiary of Rio Tinto Zinc Corp., Ltd., continued exploration drilling on its fluorspar-barite prospect in the Sweetwater district, southwest of Knoxville, Tenn. Major discoveries have been announced in McMinn, Monroe, and Loudon Counties which could total 50 million tons of fluorspar ore assaying 15% to 30% CaF_2. Allied Chemical Co. continued active exploration of many fluorspar prospects in New Mexico and Colorado. Ozark-Mahoning Co. performed a limited amount of exploration drilling on unpatented claims in northern Colorado.

Reynolds Mining Co. at Eagle Pass, Tex., operated a fluorspar froth flotation plant which has a rated output capacity of 90,000 tons annually of acid-spar. Reynolds continued its practice of buying fluorspar ore of variable grades in Mexico, of impounding it under general imports (tariff duty free), of processing the ore in the flotation plant, and of producing quality acid-spar, containing 97% plus CaF_2. Then the acid-spar was passed through U.S. Customs as imports for consumption. Most of the 1974 output was used by Reynolds to make electrofluxes for its alumina smelting operations, but some was sold on the open market. Although this plant was located in the United States it did not process U.S. ore; therefore, it is not listed in table 2.

Table 2.—U.S. fluorspar-producing mines and mills in 1974

State	Company	Mines	Plants[1]
Colorado	Ozark-Mahoning Co	Cowdrey[2]	Flotation and briquet.
Illinois	Hastie Mining Co	Spar Mountain	None.
Do	Minerva Oil Co	6 mines	2 flotation.
Do	Ozark-Mahoning Co	5 mines	Flotation and briquet. 2 heavy-media.
Do	Tamora Mining Co	1 mine	None.
Kentucky	Cerro Spar Corp	Babb-Barnes	Flotation.
Do	Minerva Oil Co	Lafayette	None.
Do	Minerals Exploration Co	Haffaw	Do.
Montana	Roberts Mining Co	Crystal Mountain[2]	Heavy-media.
Nevada	J. Irving Crowell, Jr. & Son	Daisy	None.
Do	Spor Bros	Mary	Do.
New Mexico	Mining and Milling Co. of America	Volcano	Flotation.
Texas	D & F Minerals Co	Paisano	None.
Utah	U.S. Energy Corp	Fluoride Queen	Do.
Do	Willden Fluorspar Co	Lost Sheep	Do.
Do	Spor Bros	Fluoride	Do.

[1] Of the nine plants shown only four were full time operations.
[2] Output from inventory only.

Seven fluorspar briquetting or pelletizing plants operated during 1974. These plants furnished fluxing material for the iron and steel industry and cannot be classified either as producers or end use consumers of fluorspar. They were beneficiators or convertors of fluorspar ore into a more usable product. The compaction blend contained fines, gravel, or filter cake containing from 35% to 97% CaF_2. Additions of lime, limestone, and oxides of manganese, iron, aluminum, titanium, boron etc., as well as cinders, were made to fulfill customer requirements; consequently, the CaF_2 content of the primary blend was diluted by a factor of up to at least 1.5.

The briquetting industry operated at 60% of capacity during 1974, and produced 277,000 tons of briquets valued at approximately $20 million. Operating data for 1974 were as follows:

	Tons	Average CaF_2 content percent
Total capacity	460,000	--
Fluorspar processed, all kinds	185,000	78
Fluorspar briquets produced	276,700	58
Fluorspar briquets shipped	282,600	58

The market demand for fluorspar briquets decreased during the final quarter and stocks increased. About 90% of the fluorspar made into briquets was imported, mainly from Mexico. The location of U.S. fluorspar briquetting plants in operation during 1974 are as follows:

State	City	Company
Illinois	Rosiclare	Ozark-Mahoning Corp.[1]
Indiana	East Chicago	National Briquet Corp.
Michigan	Dearborn	Mercier Corp.
Pennsylvania	Duquesne	Cametco, Inc.
Texas	Brownsville	Delhi Foundry Sand Co., Oglebay Norton Co. and Ozark-Mahoning Co.

[1] Subsidiary of Pennwalt Corp.

Two companies each operating two plants made end use building-block-size bricks. Cleveland Flux Co. made a steel furnace liner brick containing about 93% CaF_2 that acted as a flux and metal purifier. Glen Gery Corp. made a building brick which contained about 5% of 95% CaF_2 and is used for outside wall construction. Reportedly, the fluorspar fused the vanadium salts contained in the brick thereby preventing leaching.

The fluorspar supply picture is incomplete without including the supply of fluorine derived from byproduct hydrofluosilicic acid (H_2SiF_6), which is recovered from the wet-process production of phosphoric acid. During 1973 and 1974, about 58,000 tons annually of hydrofluosilicic acid was recovered from phosphoric acid plants. Theoretically, the 79% fluorine content of this acid is equivalent to about 90,000 tons of acid-spar that would have been used to make hydrofluoric acid for the chemical and aluminum industries and for fluoridation of public water supplies.

About 57% of the H_2SiF_6 was used to make fluoride salts for use in aluminum potlines, 28% was used for other chemical products, and 15% was used in water fluoridation. The H_2SiF_6 supply is expected to increase slowly as new phosphoric acid plants are built in Florida and North Carolina, but the market has not developed rapidly.

Table 3.—Shipments of finished fluorspar, by State

State	1973			1974		
	Quantity (short tons)	Value		Quantity (short tons)	Value	
		Total (thousands)	Average per ton		Total (thousands)	Average per ton
Illinois	160,305	r $11,915	r $74.33	151,898	$12,247	$80.68
Utah	4,778	144	30.14	2,967	98	33.03
Other States [1]	83,518	5,322	63.72	46,251	1,952	42.20
Total and average	248,601	r 17,381	r 69.92	201,116	14,297	71.09

r Revised.

[1] Arizona (1973), New Mexico, Montana, Colorado, Kentucky, Nevada and Texas (1973–74).

Table 4.—Shipments and mine stocks of finished fluorspar by grade, in the United States

Grade	1973				1974			
	Quantity (short tons)	Value r 1 (thousands)	Value r per ton	Stocks [2] (short tons)	Quantity (short tons)	Value [1] (thousands)	Value per ton	Stocks [2] (short tons)
Acid	116,104	$8,577	$73.87	3,619	77,093	$6,134	$79.57	4,112
Metallurgical	132,497	8,804	66.45	5,056	124,023	8,163	65.82	9,556
Total and average	248,601	17,381	69.92	8,675	201,116	14,297	71.09	13,668

r Revised.

[1] Total value as reported by mine producers.

[2] Mine stocks as of Dec. 31.

Reserves and Resources.—U.S. minable reserves total about 17 million tons of 35% CaF_2 or equivalent, containing about 2.6 million tons of fluorine. Another 11 million tons of submarginal-grade material have been delineated in Colorado, Idaho, Illinois, Kentucky, New Mexico, and Tennessee, which, because of high mining and freight costs, are classified as identifiable resources. Another 68 million tons of inferred resources are scattered throughout 13 States as shown in table 5. U.S. resources occur mainly in Illinois, Tennessee, Alaska, Colorado, Kentucky, Idaho, and New Mexico. The known reserves occur within localized mining districts as small isolated ore bodies or clusters of ore bodies, and as irregularly shaped pods, mantos, veins, or breccia zones. The mined rock generally contains from 25% to 70% CaF_2, variable amounts of gangue calcite and quartz, and minor amounts of barite, sphalerite, and galena which may be recovered as a byproduct. Most of the deposits are of less than 500,000 tons, but a few larger low-grade deposits, containing millions of tons, may become commercially attractive if they can be mined economically and if the ore is amenable to beneficiation.

Table 5.—Fluorspar reserves and resources in the U.S. by State, 1974

(Thousand short tons)

State	Identified reserves			Identified resources			Resources		
	Quantity (total)	Grade	Quantity (contained CaF_2)	Quantity (total)	Grade	Quantity (contained) CaF_2)	Quantity (total)	Grade	Quantity (contained CaF_2)
Alaska	--	--	--	32,000	0.17	5,440	32,000	0.17	5,440
Arizona	--	--	--	300	.37	111	300	.37	111
Colorado	2,300	0.35	805	7,500	.30	2,250	9,800	.30	2,940
Idaho	3,600	.38	1,368	2,100	.37	777	5,700	.35	2,000
Illinois	7,000	.33	2,310	47,000	.15	6,970	54,000	.17	9,280
Kentucky	2,250	.37	832	4,400	.30	1,320	6,650	.31	2,061
Montana	50	.50	25	400	.38	152	450	.38	170
Nevada	300	.45	135	280	.48	134	580	.46	269
New Mexico	880	.50	440	4,000	.27	1,080	4,880	.31	1,518
Oregon	--	--	--	12,000	.08	960	12,000	.08	960
Tennessee	--	--	--	50,200	.15	7,530	50,200	.15	7,530
Texas	50	.60	30	950	.44	418	1,000	.45	450
Utah	100	.63	63	900	.55	495	1,000	.56	558
Total	16,530	.36	6,008	[1]162,030	.17	27,637	[1]178,560	.19	33,282
Equivalent tonnage[2]	17,000	.35	6,000	79,000	.35	28,000	95,000	.35	33,000

[1] Totals used by U.S. Geological Survey and agreed on by the U.S. Bureau of Mines.

[2] Total equivalent tonnage at 35% CaF_2 and then rounded. Figures quoted by the U.S. Bureau of Mines.

A resource of 50 million tons of fluorspar, ranging from 15% to 30% CaF_2 has been developed in the past 2 years by U.S. Borax and Chemical Co. in the Sweetwater district about 40 miles southwest of Knoxville, Tenn. This ore occurs in scattered replacement-type deposits in a limestone host rock and contains zinc and barium minerals which could be recovered as a byproduct. In New Mexico another new resource, the Salado deposit, containing 2½ million tons, assaying 21% CaF_2 and containing about 50% SiO_2, was delineated between 1971 and 1973. The Lost River Mining Co. deposit on Seward Peninsula, Alaska, which contains about 32 million tons of material averaging about 17% CaF_2, is still classified as a resource. Evaluation and development work continued into 1974 on this deposit.

An extensive exploration program by Allied Chemical Corp. in New Mexico from 1971 to 1974 resulted in an increase in the minable reserves and resources of this State, and an equally extensive exploration program by NL Industries, Inc. in the Challis, Idaho, area in 1972–74 increased the reserves and resources of Idaho.

In 1974, a reevaluation of western U.S. fluorspar reserves was made because, at yearend 1973, Ozark-Mahoning Co. had closed down its Northgate, Colo. mines and mill, Allied Chemical Corp. had closed its Boulder, Colo. mill and Burlington mine, and Tonto Mining and Milling Co. Inc. had closed down its small mine and mill near Pumpkin Center, Ariz. Also, during 1974, Mining and Milling Co. of America closed down its new mine and mill south of Hachita, N. Mex. Because of the decreasing production, and because estimated reserves for the western States had been reported the same for years, a Bureau of Mines field survey was carried out to reevaluate fluorspar reserves. As a result, notable reductions were made for Arizona, Nevada, Utah, and Colorado. Because mining, milling, and freight costs had increased so much, these mines were no longer competitive with imported fluorspar from Mexico. Only two mines were known to have closed because they were nearly out of economically minable ore.

Reserves estimates for the Illinois-Kentucky district have stayed the same and withstood continuing mining, mainly because operators have maintained continuous exploration programs. Also, improved beneficiating methods have been introduced to recover byproducts such as zinc, lead, and barite, and heavy-media preconcentration at or near the mine mouth has permitted operators to lower their mining grade cutoff. Consequently, the average ore grade has been reduced to about 30% CaF_2, and reserves for some of the deposits have been increased.

CONSUMPTION AND USES

U.S. consumption, as reported by over 300 consumers, increased 13% from 1,352,000 tons in 1973 to 1,525,000 tons in 1974; however, the apparent consumption as determined from the balance of production, imports, exports, and inventory adjustments indicated a 5% decrease from 1,509,000 tons in 1973 to 1,429,000 tons in 1974. The difference of about 90,000 tons between 1974 reported and apparent consumption may have been caused by consumer stockpile adjustments or inclusion of foreign material during production of met-spar briquets. As previously mentioned, the briquetting industry reported consuming 187,000 tons of primary fluorspar and shipping about 283,000 tons of briquets.

The major consuming industries were iron and steel, 47%; chemicals, 28%; and aluminum and magnesium combined, 23%. The other 2% was used to make glass, ceramics, enamels, calcium cyanamide, welding rods, cement, uranium tetrafluoride, and nonferrous metal fluxes. Demand increased in the cement industry, which uses fluorspar to lower the burning temperature of limestone and other components, and in the refining of certain nonferrous metals.

During 1974, the steel industry reported the consumption of about 644,000 tons of met-spar, of which 66% was used in basic oxygen furnaces, 17% in open hearth furnaces, and 17% in electric furnaces. Another 27,000 tons was used for iron castings, and another estimated 45,000 tons was used to make HF for pickling of stainless steel, making the total consumption about 716,000 tons. Although steel-ingot output decreased, a 4% increase in fluorspar consumption was reported for 1974. The use of met-spar including briquets ranged from 3 to 11 pounds of fluorspar per ton of steel ingot and averaged about 9 pounds. No further notable decrease in the consumption of fluorspar in steel ingot production was anticipated for the near future. Fluorspar substitutes that have been tried either require at least 50% more of the substitute material than fluorspar to perform the same fluxing and cleaning actions, or contain deleterious elements which limit their use to specialty steels or certain types of furnaces. It was reported that the use of substitutes in the iron and steel industry had advanced further in Canada than in the United States. Substitute materials, such as colemanite, bauxite, ilmenite, olivine, limonite, and red mud or mixtures of them were being used to start a furnace batch or to mix with fluorspar to make briquets.

In 1973 and 1974, briquetting companies started a new trend that has increased the tonnage of briquets used and decreased the actual calcium fluoride consumption. Instead of changing to 100% substitutes, steel companies requested briquetting companies to mix acid-spar and met-spar with limestone, lime, and some of the acceptable fluxing substitutes thereby reducing the actual calcium fluoride content of some briquets to below 60%. Because some furnaces emit significant quantities of fluorine particulates or fluorine gas, it was anticipated that use of fluorspar substitutes will be encouraged to avoid environmental problems.

During 1974, the U.S. aluminum industry produced 4,903,000 tons of aluminum ingot. At the consumption rate of 128 pounds of acid-spar per ton of aluminum, the industry consumed 314,000 tons of acid-spar. The acid-spar was used to make HF, which in turn was used to make aluminum fluoride and sodium aluminum fluoride that were used to form the molten electrolyte in alumina-smelting potlines. A small amount of acid-spar was added directly to aluminum and magnesium reduction cells during operation, as shown in table 6.

Fluosilicic acid recovered as a byproduct from the phosphoric acid industry, was an additional source of fluorine used to make aluminum-cell electrolyte. In so doing, an additional 56,000 tons of acid-spar equivalent was used by the aluminum industry, thereby increasing the total acid-spar equivalent consumed by the aluminum industry to about 370,000 tons. When the fluosilicic acid supply was added, consumption increased to about 150 pounds of acid-spar equivalent, or 70 pounds of fluorine per ton of aluminum ingot.

The aluminum companies continued, at great expense, to improve techniques for recovery of fluorine. A few companies, by using Aluminum Company of America's

(Alcoa) dry scrubbing method, reported success in recycling up to 15% of the fluorine salt particulates. Spurred by government regulations and potential economic advantages, the aluminum companies also made progress in developing electrolyte recycling techniques to reduce consumption of primary fluoride salts. It was estimated that by 1977, if recycling continued to improve, consumption could be down to 120 pounds of acid-spar equivalent per ton of aluminum.

At yearend 1974 Alcoa's new aluminum-chloride electrolytic smelting plant at Palestine, Tex., went onstream. This plant, which used only a minor amount of fluoride to eliminate excess oxide, had an annual capacity of 15,000 tons of aluminum ingot. It was reported that this process, if successful, would not replace currently operating plants, but could in time be the selected process for new plants.

During 1974, about 824,000 tons of acid-spar, domestic and foreign, was used to make HF in nine HF plants in the United States. Most of the plants were located at coastal ports in Texas, Louisiana, New Jersey, and Delaware. All, including the inland plants, were accessible by water routes.[2] Imports of HF increased 3% as shown in table 10. The chemical and aluminum industries used about equal amounts of HF. Inorganic fluorides were manufactured from HF for use as insecticides, preservatives, antiseptics, catalysts, fluxes, in fire extinguishers, and for steel pickling. Elemental fluorine gas, which is derived from HF, is used to manufacture uranium hexafluoride from tetrafluoride, to produce sulfur hexafluoride, halogen fluorides, and emulsified perfluorochemicals. Organic fluorides were the volume leaders in the chemical industry using more than half of the HF produced. Organic fluorides were manufactured by reacting anhydrous acid (99.9% HF) with chloroform or carbon tetrachloride to produce a variety of chlorofluorocarbons. As chemically stable compounds, they performed outstandingly as refrigerants, aerosol propellants, solvents, resins, and elastomers. About 45% of the fluorocarbons produced were reportedly used as aerosol propellants which in 1974 made news in the trade magazines and newspapers.[3]

During the last week of October 1974, the National Resource Defense Council petitioned the Consumer Product Safety Commission to ban the use of fluorocarbon-aerosol propellants. These proposed restrictions and others were followed by a series of accusations and denials by scientists representing both sides of the argument as to whether chlorofluorocarbons containing F-11 and F-12 do or do not affect the ozone layer in the stratosphere. The hypothesis proposed is that in the atmosphere, ultraviolet radiation releases the chlorine from the fluorocarbon and the chlorine by means of a catalytic chain reaction reduces the density of the ozone layer which shields the earth from cancer-forming ultraviolet radiation. During the first week of December, Federal legislation to ban certain uses of fluorocarbons was proposed by a member of the House of Representatives. The bill also directed the Environmental Protection Agency to contract with the National Academy of Sciences to make a study of the situation and report back to Congress within 9 months.[4]

The proposed ban and the many reviews were soon followed by an announcement by the Federal Council for Science and Technology and the Council on Environmental Quality that the Interagency Task Force on Inadvertent Modification of the Stratosphere (IMOS) would investigate the possible relation of "Freons" (fluorochlorohydrocarbons) to future reduction in the ozone content of the atmosphere. By the end of 1974, sales of fluorcarbon aerosols were down, and fluoride orders by chemical manufacturers were being delayed.

The depressed market for fluorocarbons continued into 1975. It was estimated that it may be years before a scientific solution or explanation will be widely accepted, meanwhile, about 15% of the acid-spar market will be affected.

The nuclear power industry's demand for anhydrous hydrofluoric acid, fluorine gas and uranium oxide to produce uranium hexafluoride, can be estimated from information that was made available in 1974. The 1974 acid-spar demand was estimated at 15,000 tons for treatment of 12,000 tons of U_3O_8. Approximately 1.25 tons of acid-spar was required per ton of uranium oxide (U_3O_8) to make uranium hexafluoride (UF_6) from which the fissionable U_{235} isotope was subsequently separated by gaseous diffusion.

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[2] Chemical Marketing Reporter. Chemical Profile. V. 208. No. 20. Nov. 17, 1975, p. 9.

[3] Chemical and Engineering News. Chlorofluorocarbons Threaten Ozone Layer. V. 52, No. 38, Sept. 23, 1974, pp. 27-30.

[4] Chemical and Engineering News. Environmentalists Seek Fluorocarbon Ban. V. 52 No. 48, Dec. 2, 1974, p. 14.

Chemical Marketing Reporter. Fluorocarbons in Stratosphere. V. 206, No. 25, Dec. 16, 1974, pp. 3, 18.

Federal Task Force on Inadvertent Modification of the Stratosphere (IMOS). Fluorocarbons and the Environment. June 1975, 109 pp.

In the process, purified UO_3 derived from U_3O_8 was hydrofluorinated with anhydrous hydrofluoric acid at a rate of about 1 to ⅓ to produce uranium tetrafluoride (UF_4), which was then reacted with elemental fluorine gas to produce gaseous UF_6. Then the UF_6 was passed through the gaseous diffusion plant, and the UO_2 enriched in U_{235} was separated. Since the gaseous diffusion plants went into operation, UF_6 depleted of most of the U_{235} has been stockpiled. Fluorine losses in the process were negligible. The U.S. Energy Resource and Development Administration (ERDA) reported that it had in stock about 220,000 tons of fertile uranium, probably in UF_6 containing less than 2% U_{235}. This material contained about 70,000 tons of fluorine, equivalent to about 152,000 tons of acid-spar. This large stockpile, plus possible decreased consumption per nuclear-energy unit generated by uranium, beclouds long-range predictions of increased future fluorspar demand in fabrication of nuclear fuels.

Table 6.—U.S. reported consumption of fluorspar by end use and grade in 1974
(Short tons)

End use or product	Containing more than 97% calcium fluoride	Containing not more than 97% calcium fluoride	Total
Hydrofluoric acid	824,449	--	824,449
Glass and fiberglass	11,296	5,222	16,518
Enamel and pottery	(1)	3,947	3,947
Welding rod coatings	531	(1)	531
Primary aluminum and magnesium	2,090	--	2,090
Other nonferrous metals	--	1,036	1,036
Iron and steel castings	(2)	27,055	27,055
Open hearth furnaces	--	110,670	110,670
Basic oxygen furnaces	--	422,062	422,062
Electric furnaces	2,184	108,978	111,162
Other uses or products [3]	302	4,710	5,012
Total	840,852	683,680	1,524,532
Stocks Dec. 31, 1974	128,282	302,360	430,642
Stocks Dec. 31, 1973	266,421	61,282	327,703

[1] Included with "Other uses or products."
[2] Included with containing not more than 97%.
[3] Includes fluorspar used to make ferroalloys and other furnace products.

Table 7.—Fluorspar (domestic and foreign) reported consumed in the United States, by State
(Short tons)

State	1974
Alabama, Kentucky, Tennessee	96,958
Arizona, Colorado, Utah	24,186
Arkansas, Kansas, Louisiana, Missouri	288,314
California	39,724
Connecticut, Massachusetts, New York, Rhode Island	39,666
Illinois	75,115
Indiana	68,726
Michigan	48,670
New Jersey	39,951
Ohio	194,391
Oregon and Washington	1,274
Pennsylvania	191,708
Texas	318,070
West Virginia	55,224
Other States [1]	42,555
Total	1,524,532

[1] Includes Georgia, Maryland, North Carolina, Delaware, Mississippi, Iowa, Oklahoma, and Wisconsin.

STOCKS

U.S. producers reported a 58% increase to 13,700 tons in their stocks of finished fluorspar. Domestic-consumer stocks increased 31% to 430,600 tons. No sales were made by GSA from the Government stockpile, which remained at 1,302,000 tons, broken down as follows:

	Objective	Inventory	Excess
	(thousand short tons)		
Acid grade	--	890	890
Metallurgical grade	159	412	253
Total	159	1,302	1,143

At yearend, Mexican stocks were probably less than 100,000 tons. Worldwide inventories in major producing countries started to increase at yearend.

PRICES

Domestic fluorspar prices, f.o.b. Illinois, as reported in Engineering and Mining Journal (E/MJ), increased during the first three quarters of the year. The base price of dry acid-spar increased 9% from $78.50 to $85.50 per ton, and 70% effective CaF_2 met-spar pellets or briquets increased 7% from $65.50 to $70 per ton. According to E/MJ, acid-spar imported through Wilmington, Del., increased 5% to $102.50 per ton, but no fluorspar price increases were indicated at the Rio Grande Mexican border.

The world price of fluorspar was strongly influenced by Mexican producers because they supplied about one-third of the fluorspar sold on the open market; therefore, the price of fluorspar sold to U.S. consumers was indicative of the world price and price trends. At the beginning of the year, prices reported verbally for met-spar, on the Mexican side of the border, "mid-bridge," were $57 to $60 per ton. By yearend these prices ranged from $58.50 to $63 per ton. The largest Mexican producers, with long-term sales contracts, reported that the price of Mexican met-spar, 70% effective CaF_2 grade, had not changed notably in the past 2 years. During the first quarter, wet filter cake acid-spar prices, again verbally reported, ranged from $62.50 to $65 per ton f.o.b. "mid-bridge," about the same as quoted prices in E/MJ, but by yearend prices were reported to be $65 to $73.50 per ton.

Because of the energy crisis, freight costs increased notably during the year, and rates from Brownsville or Laredo, Tex., to the U.S. interior increased to $10 per ton. When the cost of the import duty, insurance, handling, and freight was added the price for Mexican met-spar delivered to the Ohio River industrial area was $80 to $83 per ton, and the price for wet acid-spar filter cake was $5 to $10 per ton more.

In general, price increase of about 5% on fluorspar shipped from European and African countries were the direct result of increased production and freight costs. Fluctuations in money exchange rates caused some price variations, particularly of spot sales. During the last quarter, when the industrial slump began to affect domestic demand, spot-sale prices fluctuated notably, inventories began to grow, and long-term contracts were hard to obtain. Also, freight rates were reduced to more competitive levels.

Table 8.—U.S. prices of fluorspar

	1973 [r]	1974
Domestic f.o.b. Illinois-Kentucky:		
Acid-grade concentrates, dry basis, 97% CaF_2:		
Carloads	$78.50–$87.00	$85.50–$103.00
Bags, extra	6.00	9.00
Pellets, 88% effective CaF_2 (briquets)	76.50	85.00
Pellets, 70% effective CaF_2 (briquets)	65.50	70.00
Ceramic-grade, 95% to 96% CaF_2	76.50–82.00	83.50–96.00
European: f.o.b. Wilmington/Philadelphia:		
Acid-grade, duty paid, dry basis	97.50	102.50
Mexican: f.o.b. Mexico:[1]		
Metallurgical-grade, 70% effective CaF_2:		
Border, all rail, f.o.b. cars	48.50	48.50
Tampico, Mex., f.o.b. vessel	50.00	50.00
Acid-grade, wet-filter-cake, 97% CaF_2:		
Eagle Pass, Tex., bulk	60.00–62.00	60.00–62.00

[r] Revised.
[1] U.S. import duty, insurance, and freight not included.

Source: December issues of Engineering and Mining Journal, 1973 and 1974.

FOREIGN TRADE

A small quantity, approximately 6,000 tons, of fluorspar was exported, primarily to Canada. U.S. foreign trade, as in the past, continued to be with market-economy countries.

U.S. imports of fluorspar increased 10% to 1,336,000 tons equaling 94% of apparent consumption and 88% of reported consumption. Mexico continued to supply most of these imports, accounting for 80% of volume in 1974, with European and African countries supplying the remainder. Approximately 63% of U.S. imports were acid-spar, which increased 19% to 843,000 tons; the balance, mostly met-spar, was imported mainly from Mexico and decreased 3% in volume. An increasing amount of this met-spar was used to make briquets for use as a flux in steel furnaces. In addition to fluorspar, 32,000 tons of 70% hydrofluoric acid was imported, mainly from Canada, a 3% increase over 1973, and 20,000 tons of synthetic and natural cryolite was imported from 10 different countries.

Table 9.—U.S. exports of fluorspar

Year and country	Quantity (short tons)	Value
1971	12,491	$525,489
1972	2,764	183,620
1973	2,428	171,255
1974:		
Brazil	21	2,960
Canada	[1]5,546	278,208
Iran	35	2,590
Mexico	8	1,032
Peru	114	11,546
South Africa, Republic of	61	9,619
Surinam	62	9,000
Other	([2])	900
Total 1974[3]	5,847	$315,855

[1] Possible reexports.
[2] Less than ½ unit.
[3] Adjusted by the Bureau of Mines, Division of Nonmetallic Minerals.

Table 10.—U.S. imports for consumption of 70% hydrofluoric acid

Country	1972		1973		1974	
	Quantity (short tons)	Value	Quantity (short tons)	Value	Quantity (short tons)	Value
Canada	12,946	$4,510,698	30,196	$9,295,461	30,595	$11,342,004
Germany, West	([1])	692	([1])	897	--	--
Mexico	1,225	404,208	1,467	527,110	1,903	738,277
Total	14,171	4,915,598	31,663	9,823,468	32,498	12,080,281

[1] Less than ½ unit.

Table 11.—U.S. imports for consumption of fluorspar, by country and customs district

Country and customs district	1973 Quantity (short tons)	1973 Value [1] (thousands)	1974 Quantity (short tons)	1974 Value [1] (thousands)
CONTAINING MORE THAN 97% CALCIUM FLUORIDE				
Brazil: New Orleans	10,705	$569	--	--
Canada: Galveston	--	--	642	$25
Germany, West: Detroit	4,925	244	--	--
Guatemala: El Paso	90	5	--	--
Italy:				
Galveston	52,140	3,198	39,838	2,630
New Orleans	6,247	386	--	--
Total	58,387	3,584	39,838	2,630
Japan: Philadelphia	--	--	5,031	317
Mexico:				
Detroit	1,014	32	--	--
El Paso	90,474	3,638	111,438	5,573
Galveston	--	--	6,639	403
Honolulu	--	--	231	13
Houston	148	8	3,248	173
Laredo and Brownsville	262,188	11,318	455,264	23,120
Los Angeles	78	5	--	--
New Orleans	48,218	3,028	15,756	1,016
Nogales	703	25	--	--
Philadelphia	--	--	10,843	568
San Diego	312	14	--	--
Total	403,135	18,068	603,419	30,866
Morocco: Galveston	--	--	5,457	353
Mozambique: New Orleans	7,578	371	20,636	1,152
Portuguese West Africa, n.e.s.: New Orleans	9,932	615	--	--
South Africa, Republic of: New Orleans	--	--	3,035	158
Spain:				
Cleveland	28,814	1,688	44,004	2,746
Detroit	13,899	934	--	--
Galveston	2,832	198	--	--
Philadelphia	114,780	7,031	111,647	6,668
Total	159,825	9,846	155,651	9,414
Switzerland: Philadelphia	5,804	348	--	--
Tunisia:				
Detroit	5,430	250	--	--
New Orleans	19,610	1,095	9,311	499
Total	25,040	1,345	9,311	499
United Kingdom:				
Cleveland	6,984	437	--	--
New Orleans	13,487	797	--	--
Total	20,471	1,234	--	--
Grand total	705,892	36,229	843,020	45,414
CONTAINING NOT MORE THAN 97% CALCIUM FLUORIDE				
Canada: Portland, Maine	24	([2])	--	--
Guatemala: El Paso	348	7	--	--
Mexico:				
Baltimore	19,141	768	45,202	1,815
Buffalo	29,149	1,246	19,741	899
Cleveland	29,831	1,520	9,373	474
Detroit	17,355	752	43	3
El Paso	29,793	866	17,516	464
Laredo	295,344	7,461	358,871	10,102
New Orleans	49,366	2,304	2,846	108
Philadelphia	18,847	792	7,148	364
Total	488,826	15,709	460,740	14,229
Spain:				
Buffalo	6,605	264	--	--
Detroit	5,175	164	29,289	1,180
New Orleans	5,477	247	--	--
Philadelphia	--	--	3,340	165
Total	17,257	675	32,629	1,345
Grand total	506,455	16,391	493,369	15,574

[1] Values were those given to U.S. Customs for f.o.b. port of egress, but they do not represent true market value.

[2] Less than ½ unit.

Table 12.—U.S. imports for consumption of cryolite

Year and country	Quantity (short tons)	Value (thousands)
1971	23,127	$5,056
1972	25,642	3,541
1973	19,789	5,052
1974:		
Canada	2,150	731
Denmark	3,920	1,370
France	596	296
Germany, West	1,693	867
Hungary	535	161
Italy	890	274
Japan	9,788	2,865
Netherlands	169	75
United Kingdom	20	8
Yugoslavia	135	42
Total [1]	19,896	6,689

[1] Only the material from Denmark is natural cryolite. All the rest is manufactured synthetic cryolite.

Note: About 1¼ tons of acid-spar are required to commercially produce 1 ton of cryolite (Na_3AlF_6); therefore, the 19,896 tons of cryolite imported in 1974 was equivalent to about 24,870 tons of acid-spar. Because only 20% of the imported cryolite is natural, the mineral cryolite is no longer considered to be a major source of fluorine and no longer justifies a separate section. The imported synthetic cryolite does represent a fluorine compound which could have been manufactured in the United States and would have consumed either fluorspar or fluosilicic acid to supply the fluorine.

WORLD REVIEW

Since 1971, when world production first peaked at over 5 million tons, world production and trade have remained steady. The top 10 fluorspar producing countries listed in table 15 accounted for about 82% of the world production. The largest importers were the United States, Japan, the U.S.S.R., Italy, and Canada, which accounted for about 90% of recorded exports. United States imports equalled about one-fourth of the world production, and about one-half of the world fluorspar trade. Approximately 31% of the world production was produced on the North American continent.

There were no major changes in market-economy country exports of fluorspar. Mexican exports increased 4% and continued to equal nearly 40% of world exports. French exports increased approximately 20% from 135,000 to 162,000 tons, and Italian exports decreased approximately 17% from 100,000 to 83,000 tons.

Fluorspar trade organizations or institutes existed throughout the world. The established organizations were: Fluorspar Producers' Development and Research Association in the United Kingdom, and the Thai Association of Fluorspar in Thailand. Newer organizations founded at yearend were the Bureau of International Technique du Spathfluor (BITS) headquartered at Brussels, Belgium, and the Instituto Mexicano De La Fluorita A.C. (IMF) headquartered in Mexico City.

In the fall of 1974, European and African fluorspar producers inaugurated BITS. Most of the major producers joined the institute, which reportedly was organized to encourage and promote the fluorspar industry, etc. Also in December 1974, the IMF was inaugurated. Mexican fluorspare producing companies represent a majority of the membership, and Mexican Government departments and agencies represent a minority. On January 24, 1975, a charter acceptable to the Mexican Government was drafted. The board of directors has 17 members; 11 represent the private fluorspar producers and the rest represent government departments or mining associations.

The U.S. Bureau of Mines was informed verbally by members of these organizations that the Institute's objectives are broad and include promoting the fluorspar industry and regulating export prices and export permits. To date, because of the plentiful supply of fluorspar on the world market, no fixed prices have been announced by the two organizations. However, IMF has already recommended Mexican export prices; it is apparent from present information that future prices of fluorspar imports into the United States may be regulated by the IMF.

Table 13.—Fluorspar: World production, by country

(Short tons)

Country[1] and grade[2]	1972	1973	1974[p]
North America:			
Canada, metallurgical grade[3] (shipments)	179,700	151,000	[e] 150,000
Mexico:			
Acid grade (exports)	430,099	421,975	NA
Metallurgical grade (exports)	696,432	700,559	NA
Unspecified[4]	22,508	74,458	NA
Total	1,149,039	1,196,992	1,226,041
United States (shipments):			
Acid grade	133,848	116,104	77,093
Metallurgical grade	116,999	132,497	124,023
Total	250,847	248,601	201,116
South America:			
Argentina:			
Acid grade[e]	19,900	15,201	16,500
Metallurgical grade[e]	46,434	35,470	38,500
Total	66,334	50,671	[e] 55,000
Brazil, metallurgical grade	[5] 78,235	77,939	[e] 86,000
Colombia, grade unspecified	4,630	[e] 4,400	[e] 4,400
Uruguay, grade unspecified	NA	NA	233
Europe:			
Czechoslovakia:[3]			
Acid grade[e]	50,000	50,000	50,000
Metallurgical grade[e]	50,000	50,000	50,000
Total[e]	100,000	100,000	100,000
France:[3]			
Acid grade	208,978	[e] [r] 190,000	[e] 190,000
Metallurgical grade[e]	111,022	100,000	110,000
Total[e]	320,000	290,000	300,000
Germany, East:[3]			
Acid grade[e]	20,000	20,000	20,000
Metallurgical grade[e]	70,000	70,000	70,000
Total[e]	90,000	90,000	90,000
Germany, West (marketable):[3]			
Acid grade	91,548	90,600	80,206
Metallurgical grade	11,016	10,902	9,652
Total	102,564	101,502	89,858
Italy:[3]			
Acid grade	272,185	231,512	[e] 244,887
Metallurgical grade	33,059	28,118	[e] 30,000
Total	305,244	259,630	[e] 274,887
Romania, metallurgical grade[e] [3]	17,000	17,000	17,000
Spain:			
Acid grade[6]	344,676	314,287	[e] 305,000
Metallurgical grade[7]	99,614	[e] 110,000	[e] 110,000
Total	444,290	424,287	[e] 415,000
Sweden:			
Acid grade	[e] 550	2,811	3,300
Metallurgical grade	[e] 450	2,299	2,700
Total	[e] 1,000	5,110	[e] 6,000
U.S.S.R.:[3]			
Acid grade[e]	230,000	240,000	245,000
Metallurgical grade[e]	240,000	250,000	255,000
Total[e]	470,000	490,000	500,000
United Kingdom:[3]			
Acid grade	155,400	132,800	[e] 132,000
Metallurgical grade	62,800	54,000	[e] 55,000
Total	218,200	186,800	[e] 187,000
Africa:			
Egypt, grade unspecified	990	1,663	[e] 1,750
Kenya, metallurgical grade[3]	11,527	29,468	[e] 30,000

See footnotes at end of table.

Table 13.—Fluorspar: World production, by country—Continued

(Short tons)

Country [1] and grade [2]	1972	1973	1974 [p]
Africa—Continued			
Morocco, acid grade	--	(9)	20,999
Mozambique, grade unspecified	1,575	--	--
Rhodesia, Southern, metallurgical grade [e] [3]	165	165	200
South Africa, Republic of:			
Acid grade	157,501	204,262	213,869
Ceramic grade	19,688	4,933	5,499
Metallurgical grade	55,184	22,647	10,838
Total	232,373	231,842	229,206
Tunisia:			
Acid grade	44,695	47,735	31,215
Metallurgical grade	6,046	3,633	--
Total	50,741	51,368	31,215
Asia:			
Burma, metallurgical grade [3]	248	[e] 220	[e] 220
China, People's Republic of, metallurgical grade [e] [3]	280,000	280,000	300,000
India, grade unspecified	3,418	3,097	4,237
Japan:			
Acid grade	6,830	[e] 6,600	[e] 6,600
Metallurgical grade	2,277	[e] 2,200	[e] 2,200
Total	9,107	[e] 8,800	[e] 8,800
Korea, North, metallurgical grade [e] [3]	33,000	33,000	35,000
Korea, Republic of, metallurgical grade	30,861	24,423	17,925
Mongolia, metallurgical grade [e] [3]	110,000	[r] 265,000	265,000
Pakistan, grade unspecified	2,627	1,758	1,226
Thailand: [10]			
Acid grade	14,110	38,526	[e] 59,500
Metallurgical grade	412,914	377,079	[e] 370,500
Total	427,024	415,605	[e] 430,000
Turkey, metallurgical grade [3]	[e] 1,200	2,168	[e] 2,200
Oceania: Australia, grade unspecified	967	1,728	[e] 1,750
Grand total	4,992,406	5,043,787	5,082,263

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[e] Estimate. [p] Preliminary. [r] Revised. NA Not available.

[1] In addition to the countries listed, Bulgaria is also believed to have produced fluorspar, but production is not officially reported and available information is inadequate for the formulation of reliable output level estimates.

[2] An effort has been made to subdivide production of all countries by grade (acid, ceramic and/or metallurgical). Where the subdivision is available in official reports of the subject country, the data have been entered without qualifying notes; where a secondary source has been used to subdivide production by grade, the source of the basis for this subdivision has been identified by footnote. Where no basis for subdivision exists, the country entry has been identified with the notation ("grade unspecified").

[3] Information on grade obtained from: Bundesanstalt Für Bodenforschung Hannover and Deutsches Institut Für Wirtschaftsforschung Berlin. Untersuchungen über Angebot und Nachfrage Mineralischer Rohstoffe IV—Flusspat, March 1974, p. 39.

[4] Figures represent the difference between reported exports (divided by grade) and total production (reported with differentiation by grade).

[5] Figures reported represent total marketable product, which includes directly salable mine product and concentrate produced from ores that are not usable without beneficiation. Gross mine production of all grades reported in some sources totaled 694,000 tons in 1972, 623,000 tons in 1973 and 650,000 tons (estimated) in 1974. Much of this material requires beneficiation.

[6] Figures reported represent total officially recorded mine production of salable acid grade fluorspar from both fluorspar mines and lead-zinc-fluorspar mines plus estimate for the production of salable acid grade fluorspar obtained by beneficiating a portion of total officially recorded salable metallurgical-grade fluorspar output. Total officially recorded acid-grade fluorspar output was as follows in short tons: 1972—279,843; 1973—264,360; 1974—282,788. Estimated production of acid-grade fluorspar from beneficiated metallurgical grade fluorspar was as follows in short tons (with quantities of metallurgical-grade fluorspar recorded as being processed given in parentheses): 1972—64,832 (reported 162,080); 1973—49,927 (estimated 125,049); 1974—22,313 (estimated 56,013).

[7] Figures reported represent the difference resulting from the subtraction of that quantity of metallurgical-grade fluorspar consumed in beneficiation plants for the production of acid-grade fluorspar (see footnote 6) from total recorded metallurgical-grade fluorspar output from both fluorspar mines and lead-zinc-fluorspar mines. Recorded total mine output of metallurgical-grade fluorspar was as follows in short tons: 1972—261,694; 1973—235,049; 1974—166,013.

[8] Includes materials recovered from lead-zinc mine dumps.

[9] Although official sources recorded no production, there are indications that at least test lots were produced.

[10] Acid grade material reported from Thailand is an estimate of the quantity of beneficiated product resulting from processing of low-grade material officially reported; metallurgical-grade material is run-of-mine production reported under the term "high grade" in official sources. Recorded production of low-grade material follows in short tons: 1972—22,575; 1973—61,646; 1974—88,000 (estimated).

Table 14.—Fluorspar: World trade[1] by source and destination, 1973

(Short tons)

Source	Destination								
	Australia[2]	Austria	Belgium-Luxembourg	Canada	France	Germany, West	Italy	Japan	Netherlands
Argentina	--	--	--	--	--	--	--	3,275	--
Austria[3]	--	XX	--	--	--	--	--	--	--
Belgium-Luxembourg[3]	--	--	XX	--	--	--	--	--	[4]9
Brazil	6,944	--	--	--	--	--	--	5,787	--
Canada	--	--	--	XX	--	1,080	--	--	--
China, People's Republic of	1,335	--	735	--	1,093	--	--	174,522	--
France	--	3,577	7,452	--	XX	[4]93,922	15,484	--	730
Germany, East	--	7,927	1,896	--	--	--	--	--	--
Germany, West	--	4,990	3,086	--	1,723	XX	136	--	311
Greece	--	--	--	--	--	--	725	--	--
Italy	5,185	2,382	67	--	1,176	12,833	XX	--	[4]2,535
Japan	--	--	--	--	--	--	--	XX	--
Kenya	--	--	--	--	--	--	--	26,608	--
Korea, North	--	--	--	--	--	--	--	8,034	--
Korea, Republic of	--	--	--	--	--	--	--	19,314	--
Malaysia[3]	--	--	--	--	--	--	--	2,061	--
Mexico	--	--	--	100,908	--	--	9,359	--	[4]5,166
Mongolia	--	--	--	--	--	--	--	--	--
Mozambique	--	--	--	--	--	--	--	34	--
Netherlands[3]	--	--	99	--	1	765	--	--	XX
South Africa, Republic of	17,603	--	--	--	1,615	39	2,769	125,159	--
Spain	--	--	--	18,595	1	46,284	1,605	--	--
Sweden	--	--	--	--	--	--	--	--	--
Switzerland[3]	--	154	--	--	--	98	--	--	--
Thailand	--	--	--	--	--	2,975	--	265,750	[4]3,527
Tunisia	--	--	--	--	--	--	11,210	--	--
U.S.S.R	--	--	--	--	--	--	--	446	--
United Kingdom	2,230	--	463	39,099	1,080	--	--	1,829	--
United States	--	--	--	10,951	--	--	--	([5])	--
Unspecified and other	138	45	288	--	3	70,858	2	--	10,384
Total	33,435	19,075	14,086	169,553	6,692	228,854	41,290	632,819	22,662

Source	Destination							Total receipts by listed countries	Total recorded exports
	Norway	Poland	Sweden	U.S.S.R.	United States	Yugoslavia	Other [6]		
Argentina	--	--	--	--	--	--	--	3,275	1,008
Austria[3]	--	--	--	--	--	989	--	989	284
Belgium-Luxembourg[3]	--	--	--	--	--	--	--	9	614
Brazil	--	--	--	--	10,705	--	[7]1,312	24,748	27,487
Canada	--	--	--	--	24	--	--	1,104	[e]1,200
China, People's Republic of	110	12,744	5,979	54,234	--	--	173	250,925	[e]260,000
France	--	--	3,674	--	--	--	[8]4,217	129,056	135,896
Germany, East	748	--	1,735	--	--	3,428	--	15,734	[e]20,000
Germany, West	--	26,366	3,905	--	4,925	289	[8]5,487	51,218	19,170
Greece	--	--	--	--	--	--	--	725	[e]1,000
Italy	3,751	--	33	--	58,387	198	[7]2,098	88,645	100,862
Japan	--	--	--	38,140	--	--	[7]45	38,185	[9]19,889
Kenya	--	--	--	--	--	--	--	26,608	[10]26,742
Korea, North	--	--	--	--	--	--	--	8,034	[e]10,000
Korea, Republic of	--	--	--	--	--	--	[7]1,651	20,965	17,516
Malaysia[3]	--	--	--	--	--	--	--	2,061	[e]2,100
Mexico	--	--	--	--	891,961	--	[7]3,543	1,010,937	1,122,534
Mongolia	--	--	--	264,334	--	--	--	264,334	[e]265,000
Mozambique	--	--	--	--	7,578	--	--	7,612	[e]7,700
Netherlands[3]	--	--	--	--	--	--	12	877	949
South Africa, Republic of	--	--	1,577	--	--	--	2,550	151,312	231,842
Spain	8,696	--	--	--	177,082	--	[8]5,656	257,919	264,229
Sweden	58	--	XX	--	--	--	194	252	518
Switzerland[3]	--	--	--	--	5,804	--	231	6,287	[e]6,300
Thailand	--	--	--	45,525	--	--	[8]4,785	322,562	303,695
Tunisia	--	--	--	--	25,040	--	--	36,250	36,398
U.S.S.R	--	--	--	XX	--	--	--	446	[e]1,000
United Kingdom	22,915	--	509	--	20,471	--	1,289	89,885	[11]91,271
United States	--	--	--	17,968	XX	--	[8]234	29,153	2,428
Unspecified and other	54	719	7	10,802	10,370	--	12	103,682	--
Total	36,332	39,829	17,419	431,003	1,212,347	4,904	33,489	2,943,289	2,976,582

See footnotes next page.

[e] Estimate. XX Not applicable.

[1] Compiled from official import data of listed countries of destination except where otherwise specified by footnote; figures in total receipts by listed countries column are simply summations of reported imports for all listed destinations, in contrast to figures in total recorded exports column which are either (1) actual reported exports of listed source countries, or (2) estimates of total exports. Differences between these two columns are attributed to (1) time lag between date of shipment and date of receipt, (2) concealment policies of some countries, and/or (3) reshipment of material by intermediate countries which may be credited as the origin in the trade returns of the final destination countries.

[2] Imports for year beginning July 1, 1978.

[3] No recorded production of fluorspar; exports are apparently derived from imported materials.

[4] Official import statistics show no receipts from this country, but do include a substantial quantity of material from undisclosed sources. Figure entered here represents reported export of source country to this destination. (An equal amount has been subtracted from the destination country's reported import from undisclosed sources.)

[5] Less than ½ unit.

[6] Data compiled from official import statistics of six nations and export statistics of nine significant producing nations, the latter to determine apparent imports for 20 other countries for which official fluorspar import figures are not available. Nations reporting imports and total recorded imports for each are as follows in short tons: Brazil 115; Denmark 2,282; Finland 4,639; India 746; Mexico 10; Spain 26. Nations for which apparent imports have been derived, and apparent imports for each are as follows in short tons: Argentina 2,967; Bulgaria 187; Czechoslovakia 2,585; East Germany 3,847; Greece 165; Guatemala 331; Hungary 1,725; Malaysia 432; Philippines 780; Portugal 1,049; Romania 1,248; Singapore 179; the Republic of South Africa 146; Sri Lanka 23; Switzerland 2,587; Taiwan 3,836; Thailand 424; Tunisia 77; Venezuela 3,212; South Vietnam 369.

[7] Figure compiled exclusively from official export statistics of the country of origin (see also footnote 6).

[8] Figure compiled from both the official import statistics of the countries of destination and official export statistics for the country of origin (see also footnote 6).

[9] Figure includes fluorspar as well as any nepheline and/or nepheline syenite exported.

[10] Figure includes fluorspar as well as any feldspar, nepheline and/or nepheline syenite exported.

[11] Estimate by the United Kingdom Institute of Geological Sciences.

Canada.—Nearly all of Canada's fluorspar production continued to come from the Burin Peninsula of Newfoundland, where the Newfoundland fluorspar works of Alcan Aluminum Ltd. (Alcan) operated two mines near the town of St. Lawrence. According to an official of Alcan, production was about 160,000 tons of heavy-media, met-spar of about 65% CaF_2, which was shipped to Arvida, Quebec, for processing into about 100,000 tons of acid-spar concentrate which was processed into aluminum smelter fluxes. But on table 13, preliminary estimates indicate Canadian production at 150,000 tons, which may have included some met-spar.

Although fluorspar imports reportedly decreased from 1973, Canada continued to import a little more fluorspar than was produced domestically. Most of the imported fluorspar was flotation concentrate containing more than 95% CaF_2. About 35,000 tons of met-spar gravel was imported for the steel industries. It was reported that many Canadian steel foundries were using ilmenite and olivine as a fluorspar substitute.

Of the total estimated fluorspar supply of about 317,000 tons, approximately 11% was used by the steel industry, 88% was used by the aluminum and chemical industries, and less than 1% was used by the glass, fiberglass, and enamel industries.

The only active fluorspar exploration reported was on the Burin Peninsula of Newfoundland, near where Alcan operates the Blue Beach and Tarefare mines, and one heavy-media plant. A new mine, Tarefare No. 2, which was to replace one of the mines that was nearly depleted, was still being developed and probably will not obtain full production until 1976.

Fluorspar mining in Newfoundland was started in 1933 by St. Lawrence Corp. In 1940, Newfoundland Fluorspar Co., a wholly-owned subsidiary of Alcan, opened the Director mine, 1.25 miles west of St. Lawrence. In 1962, St. Lawrence Corp. stopped all ore shipments; and in 1965, all local assets were sold to Newfoundland Fluorspar Co. In 1970, Newfoundland Fluorspar Co. was liquidated and became an operating division of Alcan. Since then, the mined and upgraded ore has been shipped to Arvida, Quebec, where it was processed in a flotation plant and used to make aluminum fluoride for Alcan's aluminum smelter. The ore occurs as veins ranging from 3 feet to 23 feet wide containing 60% to 95% CaF_2. The veins have been mined and developed from the surface to 1,400 feet deep. Mining has been plagued with large amounts of water and radon gas emission.[5]

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[5] The Northern Miner. Alcan Readying Fourth Fluorspar Mine. V. 60, No. 12, June 6, 1974, pp. 1, 15.

Table 15.—Production and exports of the ten largest fluorspar-producing countries
(Thousand short tons)

Country	Production 1973	Exports 1973	Production 1974 p	Exports 1974
Mexico	1,197	1,123	1,226	1,165
U.S.S.R.e	490	1	500	1
Thailand	416	304	e 430	337
Spain	424	264	e 415	275
France	290	135	300	161
China, People's Republic of e	280	e 260	e 300	e 230
Italy	260	100	e 275	88
Mongolia e	265	e 265	265	265
South Africa, Republic of	232	232	229	e 230
United States	249	2	201	6

e Estimate. p Preliminary.

China, People's Republic of.—China has been an important world producer of fluorspar for several years, and output in 1974 likely totalled 300,000 tons. A large surplus has been traditionally exported, mainly to Japan. Imports of Chinese fluorspar by Japan reached an alltime high of 197,300 tons in 1974, and imports by the U.S.S.R. in 1973 (the latest figure) was 54,000 tons. Poland was also importing as much as 13,000 tons for a single year. Most Chinese fluorspar appearing in the world markets was metallurgical grade, which was marketed predominantly to steel producers. Very high-grade lump fluorspar was recently offered in the U.S. market. Although still at low levels, fluorspar consumption in China has steadily increased. Possibly 100,000 tons of fluorspar was consumed in 1974; at least 50,000 tons by the steel industry and 50,000 tons by the aluminum and chemical industries.

Historically, the leading producing districts have been Wu-yi in Chekiang Province, Kaip'ing in Liaoning Province, and Lung-hua in Jehol Province. Fluorspar also has been mined in Shantung and Kwangtung Provinces. A new mine has come into prominence in recent years; namely the Taolin in Hunan Province, which also produces lead-zinc. A flotation plant at the mine has a reported capacity of about 80,000 tons annually. Another recently developed fluorspar operation is located in Pecheng, Fukien Province. There may not be many potential fluorspar deposits associated with lead and zinc since such deposits are uncommon according to present geological knowledge of the country.[6]

France.—Fluorspar production increased about 3% to approximately 300,000 tons, 63% of which was acid-spar averaging 98% CaF_2 and the remainder, met-spar averaging 80% CaF_2. Four companies produced 80% of this fluorspar which was recovered from 727,000 tons of washed ore. Ore assays have decreased every year from 63% CaF_2 in 1970, to 49% CaF_2 in 1974. Domestic fluorspar consumption decreased 7% to 231,000 tons of contained CaF_2. Approximately 100,000 tons of met-spar was consumed by the steel industry and 5,000 tons by the ceramic industry; the remainder, acid-spar, was used to produce aluminum fluoride, cryolite, and other fluorine compounds.[7]

Fluorspar exports, 69% to West Germany, increased 19% to 161,000 tons, of which 7 tons was met-spar and the remainder acid-spar. A small quantity, 5 tons, was imported, mostly met-spar. Two of the larger producers were Péchiney Ugine Kuhlmann of Haute Laire and Ste. de Concentration des Mineraux Fluores, in the Pyrenes.

Italy.—Italian production, trade, and consumption for 1973 and 1974 were as follows, in thousand short tons:

	Production	Exports	Imports	Consumption
1973	260	100	41	201
1974	275	83	74	266
Change	+6%	−17%	+80%	+32%

Most of the 1974 exported material was acid-spar and about half of it went to the United States. About 70% of the imported material was met-spar, from Tunisia, France, and Mexico.

About 60% of Italy's production continued to come from the island of Sardinia. Fluorsarda, a subsidiary of the Sardinian Mining Agency began a 3-year exploration program in the Sarrabus-Serrei and Sarcindano areas.

Ente Gestione Aziende Mineraria S.p.A. (EGAM), the Italian Government holding company, in fulfilling its commitment of a national mining policy, expanded into the nonmetallic field especially in Sardinia. EGAM prefers to operate its own mines; but where this is not feasible they acquire a minority participation in local companies. They have also made proposals to enter into long-term purchase agreements and joint undertakings with producing countries to assure Italy adequate supplies of raw materials.

The major fluorspar mining companies in Italy were as follows: Soc. Mineraria Silius S.p.A., (C.E. Giulini Gp) Cagliari Province, Soc. Montedison, Bergamo, Brescia and Trento Provinces, Montecatini-Edison S.p.A., Northern Italy, Soc. Pertusola, Cagliari Province, Soc. Mineraria Prealpina, Bolzano Province, Fluorsid S.p.A. (C.E. Giulini Gp), Assemini, Cagliari Province and Southland Mining Ltd. (Soc. Rich. Colt. Minerarie-Pianciano) Rome Province.

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[6] K. P. Wang, The People's Republic of China, A New Industrial Power With A Strong Mineral Base. Bureau of Mines, U.S. Department of Interior. 1975, p. 80.

[7] Annales des Mines, France. Spath-Fluor, L'Energie, Les Métaux et Les Minerais en France en 1974. August–September 1975, p. 72–73.

Mexico.—Mexico maintained its position as the leading world producer and exporter of fluorspar, and the foremost supplier to the United States. The country's 1974 production, about one-fourth the world's production, increased 2% to 1,226,000 tons which was still below the 1971 peak of 1,302,000 tons. The majority of the larger companies continued in full production in 1974. Seven major mines have the capacity to produce about 1 million tons, or over 90% of the total.

Cía. Minera Las Cuevas, S.A., which was 51% owned by Mexican interests and 49% by Empresa Fluorspar Mine Ltd., a Noranda Mines Ltd. of Canada affiliate, was still the largest fluorspar mine in the world. The complex is located about 60 kilometers (37 miles) east of San Luis Potosí near the town of Zaragoza. According to Noranda's 1974 annual report, this mine produced 375,000 tons. Approximately 240,000 tons was gravel metspar and the rest was used to make about 80,000 tons of acid-spar. Plans were announced to increase the acid-spar capacity to 100,000 tons annually. Most of the company's fluorspar was shipped by rail to Texas, but some was shipped to Tampico, Vera Cruz, for exporting.

Table 16.—Selected fluorspar mining companies in Mexico and their approximate shipping capacity in 1974
(Thousand short tons)

Company	Location	Capacity
Cía. Minera Las Cuevas, S.A	Zaragoza, San Luis Potosí	350
Minera Frisco, S.A	Parral, Chihuahua	210
Fluorita de Mexico, S.A	Muzquiz, Coahuila	130
Fluorita de Rio Verde, S.A. (Industrias Peñoles)	Alamos de Martínez, Guanajuato, San Luis Potosí	120
Compania Minera Rio Colorado, S.A. (Industrias Peñoles)	Rio Verde district, San Luis Potosí & Guanajuato	125
Industrial Minera Mexico S.A	Parral, Chihuahua	70
Compania La Domincia, S.A	La Linda, Coahuila	75
La Valenciana, S.A	Rio Verde area, San Luis Potosí	80
Minerales Productos y Metallurgicos, S.A	San Bernardo, Durango	80
Association of Small Miners	Rio Verde, San Luis Potosí	60
Fluoros de Hidalgo, S.A	Ixmiquilpan, Hidalgo	25
Reynolds Mining Corp	Piedras Negras, Coahuila, Eagle Pass, Tex	90
Total		1,315

The combined production capacity of the 12 companies listed in table 16 totals about 1,315,000 tons of fluorspar. About 63% of the capacity is in acid-spar. Normally, they operate at about 95% of capacity.

Fluorspar continued to be Mexico's single most important mineral export, and 1974 exports increased 4% to 1,164,600 tons. This was about 95% of Mexico's production. Exports to the United States increased 19% in volume, to 1,064,000 tons, and supplied 80% of U.S. imports or 75% of U.S. apparent demand. This expansion was due entirely to increased exports of acid-spar which increased 50% in volume, to 603,000 tons, and 71% in customs-declared value. Acid-spar accounted for 57% of 1974 fluorspar exports to the United States. Export of met-spar, the only other grade of fluorspar shipped to the United States, decreased 6% in volume to 461,000 tons, and decreased 9% in customs-declared value.

Average reported customs-declared value f.o.b. foreign port was $31 per ton for met-spar, and $51 per ton for acid-spar. Average prices of fluorspar on the Mexican side of the border were held fairly steady by Mexican producers at approximately $60 per ton for met-spar and $73.50 per ton for wet acid-spar filter cake. Yearend prices on spot sales, which extended into 1975, did not fluctuate more than 3%.

Internal fluorspar consumption remained steady at an estimated 60,000 tons. The steel industry remained the largest consumer, but the combined consumption by the chemical and aluminum industries was nearly equivalent. No significant change occurred in inventories. All production was apparently consumed or exported.

In August, in response to rising production and freight costs, the National Federation of Association of Small-Scale Miners and the National Association of Small Fluorspar Producers met under the auspices of the National Mining Development Commission of the Mexican Government to force a 60% increase in the price of fluorspar. The attempt was unsuccessful, owing to world market conditions and the reluctance of the larger producers to go along with the increase.

Production costs increased during 1974 because of a 22% wage increase granted all salaried Mexicans in September, and small incremental wage increases owing to a series of labor strikes. Consequently, some increase in true export prices may be anticipated for 1975.

Currently, there are two HF acid plants in Mexico, Industrias Químicas de Mexico, S.A. (Fluor-Mex) at San Luis Potosí and Quimobasicos, S.A. (Cydsa Group) at Monterrey, Nuevo Leon, which normally consume about 20,000 and 7,000 tons per year of acid-spar respectively. The combined output of these two plants has averaged about 12,000 tons of HF annually. Progress continued on construction of the HF plant being built near Matamoros by Química Fluor, S.A. de C.V. This plant has a rated input capacity of about 155,000 tons of acid-spar and an anticipated output of about 70,000 tons of HF annually. The plant is jointly owned by the Mexican Government (Comisíon de Fomento Minero), E. I. du Pont de Nemours & Co., Minera Frisco, S.A., and Banco de Commercio. Du Pont is the plant builder and operator, and most of the output is scheduled for U.S. consumption. Completion is expected by mid-1975. When in full operation in 1976, Mexican internal consumption of acid-spar reportedly will increase fourfold.

Mongolia.—Mongolia continued as a significant world producer of fluorspar with an estimated production of 265,000 tons for both 1973 and 1974. Nearly all of this material was shipped to the U.S.S.R. Soviet aid to the Berhin fluorite mine was doubled.

South Africa, Republic of.—Fluorspar production showed a modest reduction from 1973 of about 1% to 229,200 tons. Acid-spar production was about 13 times greater than all other grades of fluorspar. Reportedly, acid-spar production greatly exceeded export and local sales causing accumulation of excessive acid-spar stocks. Met-spar gravel production decreased over 100%, and sales were made mainly to the local iron and steel industry. About 147,600 tons of all grades was exported and 20,100 tons was used internally leaving about 61,500 tons of producers' stockpiles. Since 1972, total production has decreased 1%; acid-spar production has increased 35%; and met-spar and ceramic-spar combined production have decreased 79%, indicating drastic changes in production capabilities and market outlook.

At the Buffalo fluorspar mine of General Mining and Finance Corp., Ltd., plant expansion continued to increase the company's output of acid-spar, and the Monico Fluorspar Co. of United Steel Corp. continued expansion programs. Other companies mining fluorspar in the Republic of South Africa included Vergenoeg Mining Co., Montrose Exploration Co., Bethlehem Steel Corp. and Phelps Dodge Co.

It was evident from the recent years of notable increases in acid-spar production, that the future of the industry in South Africa depended on the marketability of flotation concentrates. It was questionable, and still is, whether the world market could absorb a predicted production increase of 300,000 tons from South Africa, 200,000 tons from Europe, Morocco, and Kenya, and another 100,000 tons from Mexico by yearend 1975. Therefore, it was suggested that South African companies may be planning to briquet their oversupply of flotation concentrates or ship them to briquetting plants in iron- and steel-producing countries. At the Buffalo mine, a briquetting unit was reported to be under construction.

Fluorspar reserves of the Republic of South Africa and the Territory of South-West Africa were reported to be equivalent to about 35 million tons of 35% CaF_2, but their resources are much larger. Although the largest deposits are low grade, ranging from 15% to 20% CaF_2, they are minable by open pit methods and are economically exploitable in today's market. It was predicted that South Africa and South-West Africa will have the capacity to produce 455,000 tons annually by 1976.

The Maydon Wolf No. 5 storage and shipping facilities located at Durham, South Africa, were scheduled for completion by yearend 1975. Scheduled loading capacity was 14,000 tons per day, and by 1976 they anticipated exporting 300,000 tons of acid-spar and minor amounts of met-spar. These new port facilities were being constructed by Rennees Consolidated Ltd. Fluorspar exports that formerly were shipped from Lourenço Marques, Mozambique, will probably, in the future, be shipped from Durham.

Spain.—Production decreased about 2% to 415,000 tons, mainly due to the adjustments of the metallurgical-grade quantities which were not sold as a finished product. Spain's production did not show any increase from 1972 through 1974, although production capacity was increased.

In reports by the U.S. Embassy in Madrid, the production of fluorspar as metallurgical-grade material also included the production of mine-run ore containing 59% CaF_2, which was not a marketable finished product. This lower grade mine-run ore was probably fed into an upgrading plant to produce satisfactory 70% effective metallurgical-grade fluorspar or to a flotation plant to produce acid-spar. To keep Spain's reported figures comparable with those reported for the rest of the world for 1973 and 1974, Spain's met-spar production figures were adjusted as shown in table 13. Northern Spain, which contains most of the country's reserves, continued to annually produce the largest tonnage of fluorspar.

Fluoruros, S.A. completed installation of a briquetting circuit at their year-old Espasa fluorspar flotation plant located in Asturias. Plans were announced to increase Spain's production of aluminum, which indicates a future rise in domestic acid-spar consumption. Other companies producing fluorspar were: Minerales y Productos Derivados, S.A. in Almeria, Arlos, S.A. in Aviles, and Fluoritas Asturiannas, S.A. in Caravia.

Thailand.—During 1974, about 430,000 tons was produced representing a 3% increase over 1973 production. This represented a 54% increase to 59,500 tons of acid-spar, and a 2% decrease to 370,500 tons of met-spar. About 188,000 tons of met-spar was exported to Japan; the rest was shipped to the U.S.S.R., Singapore, Australia, Taiwan, India, the Philippines and South Vietnam. Less than 1,000 tons of met-spar was used internally in the steel industry.

Thai Fluorite Processing Co. Ltd.'s acid-spar-producing plant, located in Petchaburi Province and jointly owned by Kaiser Cement Co. (60%) and Jalaprathan Cement Co. (40%), continued in full operation during the year. This was the only fluorspar froth flotation plant in Southeast Asia. During the year the company abandoned its mining operations and adopted a policy of supplying the plant with custom ore. All acid-spar was sold to Ataka Trading Co. of Japan, and most of it was shipped to Japan.

Although Japan was trying to diversify its sources of fluorspar, the country still imported over 65% of its demand from Thailand. Universal Mining Co. Ltd., which was controlled by Japanese interests, continued to operate its heavy-media separating plant in the Ban Hong district near Chiengmai, Lamphun Province.

About 155 fluorite deposits have been identified in Thailand. During 1974, an average of 76 deposits were worked and regularly employed about 6,600 people. During the last 4 months, employment dropped until there were only about 5,000 people employed in mining at yearend. Thailand was among the top five countries in world production and reserves. Thailand's reserves were estimated to be about 30 million tons of fluorspar containing about 35% CaF_2, but it was believed that only half could be classified as economically minable. Potential resources are large.

The domestic price of met-spar averaged $38.35 per ton on the Bangkok market for the first 6 months, but by yearend increased to about $46 per ton. The export price, f.o.b. port of Bangkok, was usually $1 to $3 more per ton, and this price also increased toward the end of the year. At the beginning of the year, acid-spar was quoted at $65 per ton, but by yearend the price was up about 15%, f.o.b. port of Bangkok. The rising value of fluorspar at yearend reflected increased costs of wages and fuel.

No further activity was reported on the January proposal by a Thai-Australian venture to build a $2 million flotation plant in the Cha-am area to produce 150,000 tons annually of chemical-grade fluorspar.

Effective July 10, 1974, the Royal Thai Government Customs Department reduced import tariffs on natural cryolite, chiolite, fluorspar, and on synthetic fluorine salts and fluorosilicates from 30% to 10% ad valorem.[8]

United Kingdom.—Estimated production was 187,000 tons, about the same as for 1973. Acid-grade production was down, but metallurgical-grade production was up. Exports were down a little and mining operations continued at about 75% of capacity. Continued disruptions in domestic and European markets, due to worldwide industrial recession, made a soft market. A recent evaluation of the United Kingdom fluorspar reserves resulted in an estimate of 24 million tons containing the equivalent of 35% CaF_2. Of this total, about one-fifth is considered as proven ore and the rest is considered as indicated and inferred reserves. The two major fluorspar mining companies were Laporte Industries Ltd., and Industrie des Metaux (G.E. Giulini Gp).

TECHNOLOGY

Environmental restrictions or controls have required technological changes in the fluorspar industry; however, it was acknowledged that meeting the various restrictions required additional investment and caused significant increases in cost of production, which have resulted in loss of capacity and even shutdowns of mines or mills. In Illinois and Colorado, the disposal of mill tailings created a problem because, even after impounding and clarification, the liquid mill effluents contained traces of chemicals that were considered deleterious and in violation of some environmental standards. The lack of uniformity in the standards set by different States and the Federal Environmental Protection Agency hindered industry in selection of proper technology and in future planning. Uniform controls are needed to prevent disruption of the industry as well as a loss of reserves.

To date, environmental problems have mainly affected users of fluorine salts, such as the chemical and aluminum industries. Restrictions already have been established on the permissible quantity of fluorine gases emitted from aluminum potlines. Most of the major aluminum companies have complied or were in the process of complying.

Throughout the country, about 2 parts per million fluorine has been the standard for fluoridation of public drinking water. Some natural streams analyzed double this amount. Some state regulatory departments were careful not to lower their control standards below the normal amounts found in nature.

The Federal Bureau of Mines Albany, Oreg., Metallurgy Research Center continued research on fluorine recovery technology. A program to study the recovery of fluosilicic as a byproduct during the production of phosphoric acid was in a semicontinuous miniplant stage. The acid can be converted to synthetic fluorspar, aluminum fluoride, or cryolite. In a concurrent investigation, recovery of fluorine from low-grade fluoride ores was being studied.

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[8] U.S. Embassy, Bangkok, Thailand. State Department Airgram A-203, July 25, 1974. 47 pp.

Gallium

By E. Chin [1]

Domestic production of gallium in 1974 declined substantially from the 1973 output. Although data on world production of gallium metal are not available, estimated world output in 1974 was about 10,000 kilograms. Most of the consumption of gallium continued to be in the production of intermetallic compounds such as gallium arsenide and gallium phosphide, which were used to manufacture light-emitting diodes for optoelectronic visual display panels.

Table 1.—Salient gallium statistics
(Kilograms)

	1971	1972	1973	1974
United States:				
Production -----	W	W	W	W
Imports for consumption -	2,671	6,066	11,124	6,536
Consumption ---	2,289	5,076	8,496	6,941
Price per kilogram dollars --	750	750	750	750

W Withheld to avoid disclosing individual company confidential data.

DOMESTIC PRODUCTION

Production of gallium metal in 1974 was by three companies. Gallium metal was produced as a byproduct of alumina production by the Aluminum Co. of America (Alcoa) at its Bauxite, Ark., plant. Gallium metal, oxide, and trichloride were produced by Eagle-Picher Industries, Inc., at its Quapaw, Okla., facility. Canyonlands 21st Century Corp. produced some gallium metal at its Blanding, Utah, plant. In addition, gallium metal and compounds derived primarily from imported material were supplied by Atomergic Chemetals Co., Cominco American, Inc., European Electronics, Inc., B. Freudenberg, Inc., Indium Corp. of America, and Kawecki Berylco Industries, Inc.

Alcoa completed construction of its new gallium extraction and refining plant at Bauxite, Ark., in mid-1974. The $1 million facility uses Alcoa's proprietary gallium production technology and reportedly triples the company's production capacity for gallium metal.

Scientific Gas Products, Inc., Edison, N.J., developed a new process for recovering high-purity gallium from gallium arsenide and gallium phosphide scrap material. The recovered gallium is reportedly of 99.999% purity. The company established facilities to process scrap material, either on a fee basis or by purchasing the scrap and reselling the pure gallium.

CONSUMPTION

The largest use for gallium was in optoelectronic applications, principally in the form of gallium arsenide and gallium phosphide, which are used in light-emitting diodes (LED's). LED's emit infrared light, have a long service life, and consume little electrical power, and were increasingly used in visual display systems in calculators, digital clocks and watches, medical instrumentation, multiple warning lights, and instrumentation for aircraft and automotive dash panels. Gallium arsenide continued to have extensive application in the field of microwave devices, where it operates efficiently beyond the cutoff frequencies of silicon-base diodes. The manganese-doped magnesium-gallium spinel ($MgGa_2O_4$:Mn) is a green phosphor used in ultraviolet excitation and was used in fluorescent lamps in Xerox copying machines. Gallium compounds were also used in semiconductor applications for microswitching devices and in laser applications. The intermetallic compounds, vanadium-gallium and columbium-gallium, were used as superconductors with a high transition temperature and a high critical field.

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[1] Physical scientist, Division of Nonferrous Metals.

Approximately 97% of the gallium consumed in 1974 was for electronic applications. Major consuming firms included Bell & Howell Co., Bell Telephone Laboratories, Inc., Hewlett-Packard Laboratories, Laser/Diode Laboratories, Inc., Litronix Inc., Monsanto Co. (Monsanto), Motorola, Inc., Opcoa, Inc., RCA Corp., Texas Instruments, Inc., Texas Materials Laboratories, Inc., and Western Electric Co., Inc.

Arthur D. Little, Inc., of Cambridge, Mass., announced the formation of a new enterprise to be known as Intermat Corporation. The firm will design, manufacture, and sell high-pressure and high-yield furnace systems to produce commercial quantities of electronic materials such as gallium arsenide and gallium phosphide. A new company, Compound Semiconductor Materials, Inc., Stephenville, Tex., was formed to produce large quantities of single-layer, liquid-phase epitaxial gallium phosphide wafers, which are green-emitting materials. Other products will include yellow wafers and materials for high-efficiency infrared emitters. Another new company, Optical Diodes, Inc., manufactured optoelectronic components and subsystems. Some of the products offered by the firm include gallium arsenide, gallium arsenide-phosphide, and gallium phosphide devices; displays for calculators, clocks, and wristwatches; and optoelectronic instrumentation and systems.

Table 2.—Consumption of gallium, by end use
(Grams)

End use	1973	1974 p
Alloys [1]	30,597	5,357
Electronics [2]	8,349,910	6,703,304
Research and development	115,865	112,307
Unspecified uses	100	120,500
Total	8,496,472	6,941,468

p Preliminary.
[1] Specialty alloys.
[2] Light-emitting diodes, semiconductors, and other electronic devices.

STOCKS

Consumer stocks of gallium metal, low- and high-purity grades, totaled 560,711 grams as of December 31, 1974. Stocks a year earlier were 1,091,203 grams. Gallium metal stocks held by producers and suppliers were as follows:

Yearend—	*Grams*
1971	402,875
1972	1,005,945
1973	948,947
1974	4,037,917

Table 3.—Stocks, receipts, and consumption of gallium
(Grams)

Purity	Beginning stocks [1]	Receipts	Consumption	Ending stocks [1]
1973:				
97.0%–99.9%	14,854	9,400	10,342	13,912
99.99%	3,808	8,670	10,759	1,719
99.999%	9,200	42,275	46,422	5,053
99.9999%–99.99999%	1,113,188	8,386,280	8,428,949	1,070,519
Total	1,141,050	8,446,625	8,496,472	1,091,203
1974: p				
97.0%–99.9%	13,912	11,900	7,433	18,379
99.99%	1,719	1,950	343	3,326
99.999%	5,053	53,778	53,413	5,418
99.9999%–99.99999%	1,070,519	6,343,348	6,880,279	533,588
Total	1,091,203	6,410,976	6,941,468	560,711

p Preliminary.
[1] Consumers only.

PRICES

As the bulk of the demand for gallium is for high-purity metal (99.9999%+), published price quotations for lower grade materials were eliminated in mid-1973. Subsequently, only dealers' and producers' quotes for high-grade gallium were published. Throughout the year, the dealers' and producers' published price quotations for gallium, in dollars per gram, were $0.70 and $0.80, respectively.

FOREIGN TRADE

Exports of gallium are not reported separately and are included in the category base metals and alloys, not elsewhere classified, wrought or unwrought, waste and scrap.

Total U.S. imports of gallium in 1974 were 6,536 kilograms, valued at $4,106,742, compared with 11,124 kilograms, valued at $6,073,479, in 1973. Shipments from the Netherlands and Switzerland accounted for 98% of the total U.S. imports of gallium. The unit value of gallium imports ranged from $614 per kilogram for material from the Netherlands to $3,018 per kilogram for gallium imports from Japan. The average unit value of all gallium imports in 1974 was $628 per kilogram.

Table 4.—U.S. imports for consumption of gallium (unwrought, waste and scrap), by country

Country	1973		1974	
	Kilograms	Value	Kilograms	Value
Belgium-Luxembourg	--	--	2	$1,502
Canada	2,133	$1,102,332	59	38,070
China, People's Republic of	4	2,652	--	--
Germany, West	388	166,765	(1)	1,415
Italy	486	177,882	--	--
Japan	142	185,606	4	12,073
Netherlands	641	395,836	267	168,992
Switzerland	7,134	3,923,547	6,153	3,856,442
United Kingdom	196	118,859	51	33,248
Total	11,124	6,073,479	6,536	4,106,742

(1) Less than ½ unit.

WORLD REVIEW

Data on world production of gallium are not available. However, the estimated world output was around 10,000 kilograms in 1974. Swiss Aluminium Ltd. was the world's largest producer of refined gallium.

World producers of gallium, by company, location, and raw materials source, follow:

Country	Company	Location	Source
Canada	Cominco, Ltd	Trail, British Columbia	Zinc ore.
China, People's Republic of	NA	NA	NA.
Czechoslovakia	NA	NA	NA.
France	Alusuisse France S.A	Marseilles	Bauxite.
Germany, West	Martinswerk G.m.b.H. fur Chemische und Metallurgische Produktion.	Bergheim/Erft	Do.
	Vereinigte Aluminum-Werke A.G	Bonn	Bauxite and superpurity aluminum.
Hungary	NA	NA	NA.
Italy	Società Alluminio Veneta Azioni	Porto Marghera	Bauxite.

See footnotes at end of table.

Country	Company	Location	Source
Japan	**Dowa Mining Co., Ltd**	**Kosaka**	**Zinc ore.**
	Nippon Light Metal Co., Ltd	**Shimizu**	**Bauxite.**
	Sumika Alusuisse Gallium Ltd	**Nijhama**	**Do.**
	Toho Zinc Co	**Fujioka**	**Zinc ore.**
Norway	**Vigeland Metal Refinery A/S**	**Vigeland**	**Super-purity aluminum.**
Switzerland	**Alusuisse Research Laboratories**	**Neuhausen am Rheinfall.**	**Crude gallium metal.**
U.S.S.R	**NA**	**NA**	**NA.**
United States	**Aluminum Co. of America**	**Bauxite, Ark**	**Bauxite.**
	Eagle-Picher Industries, Inc	**Quapaw, Okla**	**Zinc ore.**
	Canyonlands 21st Century Corp	**Blanding, Utah**	**Phosphorus dust and LED scrap material.**
	Scientific Gas Products, Inc	**Edison, N.J**	**LED scrap material.**

NA Not available.

TECHNOLOGY

The domestic gallium resource position was reviewed in a Geological Survey publication.[2] Gallium is so dispersed in nature that no deposits are known that could be exploited solely for its recovery.

A review of gallium discussed production, international trade, uses, and prices.[3] Future trends in supply, demand, and prices were included in the survey.

An extensive review of the literature concerning gallium was published.[4] The bulletin is an index to published articles, and the entries are cataloged as to geochemistry, purification, properties, composition, and analysis.

The Fifth International Symposium on Gallium Arsenide and Related Compounds was held in Deauville, France, September 24–26, 1974. Papers were presented on material properties, microwave and optical devices, and device technologies.

Reports on the growth of crystals for electronic uses were published.[5] Crystals of significant commercial and scientific interest were discussed, and the reasons for using specific growth techniques for particular crystals were presented.

A report on the status of LED technology was published.[6] The article reviewed the different types and colors of LED's that are commercially available or can be expected to become available in the near future.

Information concerning research on gallium arsenide for use in laser applications were published.[7] The long-range goal is to provide arrays of circuit elements capable of combining various discrete operations on guided light beams into sophisticated signal processing and communication devices and systems.

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[2] Weeks, R. A. Gallium, Germanium, and Indium. U.S. Geol. Survey. Prof. Paper 820, 1973, pp. 237–246.

[3] Roskill Information Services Ltd. The Economics of Gallium. May 1973, pp. 1–99.

[4] Breteque, P. de la. Gallium, Bulletin D'Information No. 12, Avec Bibliographie 1973–1974 (Gallium, Information Bulletin No. 12, With Bibliography 1973–1974). Alusuisse-France S.A. December 1974, 489 pp.

[5] Barrett, J., and R. H. Heil, Jr. Trends in Crystal Growing. Solid State Technol., v. 17, No. 2, February 1974, pp. 37–42.

Chu, T. L., K. Ito, R. K. Smeltzer, and S. C. C. Chu. Crystal Growth and Characterization of Gallium Nitride. J. Electrochem. Soc., v. 121, No. 1, January 1974, pp. 159–162.

Wang, C. C., F. C. Dougherty, P. J. Zanzucchi, and S. H. McFarlane III. Epitaxial Growth and Properties of GaAs on Magnesium Aluminate Spinel. J. Electrochem. Soc., v. 121, No. 4, April 1974, pp. 571–582.

[6] Craford, M. G., and D. L. Keune. LED Technology. Solid State Technol., v. 17, No. 1, January 1974, pp. 39–58.

[7] Chemical & Engineering News. Science. V. 52, No. 45, Nov. 11, 1974, p. 13.

Solid State Technology. Ion-Implanted GaAs Injection Laser Fabricated. V. 17, No. 4, April 1974, p. 51.

———. Scientists Use Proton Implantation in GaAs To Fabricate Optical Waveguide/Detector. V. 17, No. 6, June 1974, p. 13.

Gem Stones

Robert G. Clarke[1]

The production value of gem stones and mineral specimens in the United States during 1974 was estimated to be $4.6 million, an increase of 70% over that of 1973. Most of the value was contributed by the few companies which operated deposits for emerald, jade, opal, sapphire, and turquoise. Amateur collectors were important even though their total contribution was surpassed by the commercial operators. The commercial operators sold mainly to wholesale or retail outlets and occasionally to jewelry manufacturers.

DOMESTIC PRODUCTION

Gem stone production was estimated to be $1,000 or more for each of 39 States. The following States accounted for 70% of the total production value in thousands: Arizona, $1,500; Oregon, $500; Montana, $400; Nevada, $400; California, $220; and New Mexico, $200.

Gem stones are considered as one of the reliable items of value sought by people as a hedge against inflation. Added to this demand, the recent tremendous increase in American Indian jewelry has stimulated the turquoise mining industry to new records in value of output.

The Fairburn agate received its name from the town in which it was found first, Fairburn, S. Dak. Fairburns are beautiful agates noted for many fine lines in the pattern and brilliant natural colors. Because of the sharp contrasts of red, white, yellow, and black bands, they are often considered the world's most beautiful agates. Good ones sell for $5 to $100 per pound. Two articles described the collecting areas.[2]

Cape May "diamonds" are little quartz pebbles washed onto New Jersey beaches.[3] These are sold in most Cape May souvenir shops. In addition to beachcombing for the "diamond" quartz pebbles, collectors also gather pebbles of citrine, rose quartz, amethyst, smoky quartz, unakite, jasper, basanite, ilmenite, zircon, and various fossils of shellfish.

Several good quality diamonds, up to 2 carats in weight, were found at the Crater of Diamonds State Park in Arkansas, according to reports from park authorities.

Some of the world's finest sparkling quartz crystals are found in northern and western Arkansas where the collecting localities are numbered by the dozens.[4] Amateurs are permitted to collect at the commercial mine described. The record clear crystal from the operation measured 57 inches in length and 37 inches in width.

Descriptions of field trips, events, and mineral and gem stone finds were reported regularly in the following publications: Gems and Minerals, Lapidary Journal, Mineralogical Record, and Rocks and Minerals.

The quantity and value of emerald, jade, sapphire and tourmaline produced domestically were withheld to maintain confidentiality. About 9 tons of rough opal was produced and was valued at $68,000. The production of turquoise of all grades and qualities was nearly 160 tons valued at $2.0 million. Producers of gem stones in the United States, by principal gem stone reported, were as follows:

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[1] Physical scientist, Division of Nonmetallic Minerals.

[2] Linde, M. Collecting Fairburn Agates. Gems and Minerals, No. 439, May 1974, pp. 22–23.

Josiassen, S. Rockhound Paradise. Gems and Minerals, No. 439, May 1974, p. 23.

[3] Thomas, C. A. Bonus Trips in the Cape May, New Jersey Area. Gems and Minerals, No. 445, pp. 28–29.

[4] Broughton, P. L. Rock Crystal Clusters From Coleman Crystal Mine Near Hot Springs, Arkansas. Lapidary Journal, v. 28, No. 4, July 1974, pp. 724–728.

Emerald.—Big Crabtree mine, Mitchell County, N.C., operated by PBH Emerald Co., P.O. Box 163, Little Switzerland, N.C. 28749.

Jade.—Stewart Jewel Jade mine, Kobuk Village, Alaska, operated by Stewart Jewel Jade Co., 531 4th Ave., Anchorage, Alaska 99501.

Opal.—Jeppesen and Wilson mine, Clark County, Idaho, operated by Jeppesen, Wilson, and others, Rt. 2, Box 162, Idaho Falls, Idaho 83401. Operated on a daily fee-digging basis for amateur collectors.

Lorrie Lee mine, Humboldt County, Nev., operated by Charles L. Eddy, 10799 Sherman Grove, Sunland, Calif. 91040.

Royal Peacock mine, Humboldt County, Nev., operated by Harry W. Wilson, Denio, Nev. 89404.

Spencer Opal mine, Clark County, Idaho, operated by Mark L. Stetler, 1862 Ranier St., Idaho Falls, Idaho 83401. Operated on a daily fee-digging basis for amateur collectors.

Sapphire.—Chaussee Sapphire mine, Granite County, Mont., operated by Chaussee Sapphire Corp., P.O. Box 706, Philipsburg, Mont. 59858. Also sold unscreened material to tourists during the summer months.

Sapphire Village mine (Yogo Gulch), Judith Basin County, Mont., operated by Sapphire International Corp., Box 30, Utica, Mont. 59452.

Tourmaline.—Plumbago Gem mine, Oxford County, Maine, operated by Plumbago Mining Corp., P.O. Box 366, Congress Street, Rumford, Maine 04276.

Turquoise.—Aurora mine, Lander County, Nev., operated by Carico Lake Mining Co., P.O. Box 3426, Albuquerque, New Mexico 87110.

Blue Jim mine, Lander County, Nev., operated by James Elquist, Box 255, Battle Mountain, Nev. 89820.

Cortez Canyon mine, Lander County, Nev., operated by Nevada King Turquoise Co., P.O. Box 21, Searchlight, Nev. 89046.

Duval mine, Mohave County, Ariz., turquoise operations by L. W. Hardy Co., Inc., 3809 E. Highway 66, Kingman, Ariz. 86401.

Pinto Valley mine, Gila County, Ariz., operated by L. W. Hardy Co., Inc., 3809 E. Highway 66, Kingman, Ariz. 86401.

Red Mountain Turquoise mine, Lander County, Nev., operated by Donald B. Potts, Box 629, Tonopah, Nev. 89049.

Shoshone mine, Lander County, Nev., operated by Lombardo Turquoise Milling and Mining Co., Box 148, Austin, Nev. 89310.

Tina Gem mine, Lander County, Nev., operated by Richard G. Bonner, Box 948, Fallon, Nev. 89406.

Villa Grove Turquoise mine, Saguache County, Colo., operated by Clayton C. Musick, Box 101, Villa Grove, Colo. 81155.

CONSUMPTION

Domestic gem stone output went to amateur and commercial rock, mineral, and gem stone collections, objects of art, and jewelry. Apparent consumption of gem stones (domestic production plus imports, minus exports and reexports) was $401 million, about 5% less than that of 1973.

PRICES

Typical costs to a retail jeweler for a 2-week period in December 1974 for representative gem stones, based on a survey of dealers in all parts of the United States, were as follows:[5]

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[5] Jewelers' Circular-Keystone. JC-K's Colored Stone Price Index. V. 145, No. 5, February 1975, p. 51.

Gem stone	Carat weight	Median price per carat	Price range per carat
Amethyst	10	$12	$8–$20
Aquamarine	8	95	60–200
Black opal	3	300	200–1,500
Cat's-eye	10	1,000	600–5,000
Citrine	10	6.50	4–20
Emerald	1	1,100	500–7,000
Green garnet	1	275	150–400
Man's sky blue star	10	200	80–1,000
Peridot	15	40	25–60
Ruby	2	800	350–15,000
Sapphire	2	500	250–2,200
Tanzanite	5	220	200–500
Tourmaline	10	35	20–75
White/opal fiery	5	80	35–100

Turquoise prices, wholesale, per pound, Kingman, Ariz., were as follows:

Natural turquoise

	Low-grade	Medium-grade	High-grade
Kingman mine	$80	$100–125	$200–250
Castle Dome mine	80	100–125	150–200

Treated, cutting-grade turquoise

Grade 1—Blue	$60
Grade 1—Blue Green	40
Grade 1—Green	30

Treated, tumbled-polished turquoise

¼-inch = small; ¼-inch-½-inch = medium; ½-inch and up = large. The tumbled-polished turquoise is the same price regardless of size.

Grade 1—Blue	$60-$80
Grade 1—Blue Green	20-40
Grade 1—Green	20-40

Stabilized turquoise

Grade 1	$100
Grade 2	80
Grade 3	60

No survey was made of diamond prices. However, diamond price trends indicated that a 25% increase occurred in the higher range and that the lower range was unchanged.

FOREIGN TRADE

Exports of all gem materials amounted to $320.7 million, and reexports to $165.3 million. Diamond accounted for 95% of the value of exports and 92% of the value of reexports. Exports of diamond in total were 285,136 carats valued at $304.6 million. Of this total, diamond cut but unset, suitable for gem stones, not over 0.5 carat, was 50,340 carats valued at $18.1 million; and cut but unset, over 0.5 carat, was 234,796 carats valued at $286.5 million.

Reexports of diamond amounted to 1,176,132 carats, valued at $151.8 million, in categories as follows: Rough or uncut, suitable for gem stones, not classified by weight, 1,059,089 carats valued at $92.7 million; cut but unset, not over 0.5 carat, 56,686 carats valued at $13.3 million; cut but unset, over 0.5 carat, 60,357 carats, valued at $45.9 million.

The seven leading recipients of diamond exports accounted for 92% of the carats and 95% of the value and were as follows: Hong Kong, 80,627 carats valued at $87.8 million; Switzerland, 75,933 carats, at $63.9 million; the Netherlands, 36,107 carats, at $58.2 million; Japan, 37,247 carats, at $30.6 million; Belgium, 20,170 carats, at $28.6 million; West Germany, 7,822 carats, $10.9 million; and France, 4,968 carats, at $10.2 million. The six leading recipients of diamond reexports accounted for 93% of the carats and 90% of the value and were as follows: Israel, 437,476 carats valued at $41.3 million; Belgium, 383,943 carats, $33.1 million; the Netherlands, 197,919 carats, $31.0 million; Switzerland, 54,924 carats, $20.8 million; Japan, 8,812 carats, $5.3 million; Hong Kong, 12,454 carats, $5.0 million.

Exports of all other gem materials amounted to $16.0 million. Of this total, pearls, natural and cultured, not set or strung, were valued at $0.8 million. Natural precious and semiprecious stones, unset, were valued at $13.3 million; and synthetic or reconstructed stones, unset, were valued at $2.0 million. Reexports of all other gem materials amounted to $13.5 million. Reexports of pearls amounted to $0.9 million; of natural precious and semiprecious stones, unset, to $12.5 million; and of synthetic or reconstructed stones, unset, to $0.1 million.

Imports of gem materials decreased 6% in value from those of 1973. Diamond accounted for 86% of the total value of gem material imports.

Although rough and uncut diamond imports were reported from 28 countries, over 99% in value were from 10 countries as follows: The United Kingdom, 911,165 carats, $211.8 million; the Republic of South Africa, 389,222 carats, $69.0 million; Sierra Leone, 453,084 carats, $57.6 million; the Netherlands, 51,101 carats, $19.2 million; Belgium-Luxembourg, 43,260 carats, $14.8 million; Liberia, 5,724 carats, $8.7 million; Venezuela, 382,738 carats, $8.2 million; Israel, 36,878 carats, $8.1 million; Central African Republic, 131,912 carats, $6.8 million; and France, 30,501 carats, $5.7 million. Cut but unset diamonds, not over ½ carat were imported from 30 countries; however, the imports of this category from 8 countries amounted to 99% of its total value as follows: Belgium-Luxembourg, 838,552 carats, $119.7 million; Israel, 710,386 carats, $109.3 million; India, 219,250 carats, $26.5 million; the Republic of South Africa, 12,956 carats, $3.8 million; the Netherlands, 28,183 carats, $3.6 million; the U.S.S.R., 13,161 carats, $2.6 million; the United Kingdom, 16,967 carats, $2.3 million; and, France, 19,557 carats, $2.1 million.

For diamond cut and unset, over 0.5 carat, 98% in value came from the following six countries: Belgium-Luxembourg, 114,815 carats, $43.2 million; Israel, 63,234 carats, $19.6 million; the Republic of South Africa, 9,837 carats, $6.0 million; the Netherlands, 3,714 carats, $1.4 million; the U.S.S.R., 1,964 carats, $1.0 million; and, the United Kingdom, 1,742 carats, $0.9 million.

Imports of emeralds increased 16% in quantity and 4% in value. Imports of rubies and sapphires increased 8% in value. Natural pearls and parts increased 20% in value but cultured pearls decreased 4% in value. Imitation pearls decreased 19% in value. Other precious and semiprecious stones, rough and uncut, decreased 21% in value. Other precious and semiprecious stones, cut but unset, increased 16% in value and others, not in these categories, increased 21% in value. Synthetic gem stones, cut but unset, decreased 37% in value and imitation gem stones increased 29% in value.

Table 1.—U.S. imports for consumption of precious and semiprecious gem stones

(Thousand carats and thousand dollars)

Stones	1973		1974	
	Quantity	Value	Quantity	Value
Diamonds:				
Rough or uncut	[1] 2,821	[1] 460,198	2,450	412,678
Cut but unset	2,360	[r] 360,987	2,083	347,362
Emeralds: Cut but unset	[r] 750	[r] 32,865	871	34,046
Coral, cut but not set, and cameos suitable for use in jewelry	NA	2,103	NA	3,082
Rubies and sapphires: Cut but unset	NA	19,336	NA	20,960
Marcasites	NA	28	NA	249
Pearls:				
Natural	NA	368	NA	440
Cultured	NA	9,232	NA	8,874
Imitation	NA	1,257	NA	1,019
Other precious and semiprecious stones:				
Rough and uncut	NA	5,859	NA	4,646
Cut but unset	NA	25,043	NA	29,083
Other n.s.p.f	NA	1,532	NA	1,851
Synthetic:				
Cut but unset number	16,365	10,066	9,271	6,316
Other	NA	341	NA	362
Imitation gem stones	NA	[r] 8,803	NA	11,352
Total	NA	[r] 938,018	NA	882,320

[r] Revised. NA Not available.

[1] Adjusted by the Bureau of Mines.

Table 2.—U.S. imports for consumption of diamond (exclusive of industrial diamond), by country

(Thousand carats and thousand dollars)

Country	1972				1973				1974			
	Rough or uncut		Cut but unset		Rough or uncut		Cut but unset		Rough or uncut		Cut but unset	
	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value
Belgium-Luxembourg	64	10,706	1,211	147,392	68	16,836	1,159	[r] 177,317	43	14,804	953	162,926
Brazil	(1)	26	3	321	(1)	6	2	409	1	535	4	642
Canada	--	--	1	82	1	276	1	91	(1)	(1)	(1)	52
Central African Republic	207	6,587	--	--	191	7,668	--	--	132	6,766	--	--
France	33	1,564	23	1,895	6	169	24	2,441	31	5,668	20	2,150
Germany, West	(1)	31	3	324	1	301	1	94	1	72	2	207
Guyana	2	96	(1)	6	(1)	37	(1)	3	--	--	(1)	15
India	--	--	186	16,507	(1)	21	213	23,099	--	--	221	26,709
Israel	38	5,120	852	98,316	34	7,838	852	128,204	37	8,052	774	128,856
Japan	--	--	1	129	1	36	2	286	1	77	4	854
Liberia	3	1,611	(1)	67	7	5,192	(1)	406	6	8,683	(1)	5
Netherlands	37	10,948	15	2,266	55	22,209	18	4,143	51	19,193	32	4,948
Sierra Leone	164	15,593	3	324	[2] 747	[2] 78,919	(1)	40	453	57,577	1	82
South Africa, Republic of	953	100,059	27	8,286	427	83,707	24	12,833	389	68,948	23	9,786
Switzerland	47	2,269	8	1,188	1	181	5	1,429	2	251	8	1,587
U.S.S.R	--	--	35	5,802	--	--	30	5,931	--	--	15	3,609
United Kingdom	1,302	178,659	32	3,586	979	225,802	20	2,415	911	211,799	19	3,209
Venezuela	244	5,118	--	--	296	9,839	(1)	12	383	8,215	(1)	20
Other	2	237	10	1,564	7	1,161	9	1,834	9	2,038	7	1,705
Total	3,096	338,624	2,410	288,055	[2] 2,821	[2] 460,198	2,360	[r] 360,987	2,450	412,678	2,083	347,362

[r] Revised.

[1] Less than ½ unit.

[2] Adjusted by the Bureau of Mines.

WORLD REVIEW

Australia.—Descriptions of the two areas in Australia, where most of the world's sapphires are produced, was provided in a recent issue of the Lapidary Journal.[6] The Swanbrook mine, near Inverel, several hundred miles north of Sydney, New South Wales, is a strip mining operation of Dominion Mining N.L. and is one of the largest of about 50 mines in the area. Each truckload of gravel mined contains about 100 grams (2 ounces) of sapphire of which about 10% is gem quality and sold by the carat. The rest of the sapphires are sold by the kilogram to collectors. Mechanical separation by screens and sieves is done first, followed by hand-sorting to pick out the materials which cannot be separated mechanically. The mine is in a cultivated area and all land is restored to its original condition. The Queensland sapphire fields are in the vicinity of the settlement of Anakie, about 200 miles west of Rockhampton. Individual miners are allotted mining areas 66 by 66 feet. The sapphire-bearing gravel is generally not more than 3 feet deep and mining is done by hand. If water is available, the gravel is washed over a screen, but dry sorting is also practiced in this arid area of Australia.

Production of opal in Australia probably accounts for 98% of the world's supply. Several well-illustrated articles described the localities in Australia where opals are found and also the methods used to mine them.[7] At Coober Pedy, the largest field in South Australia, heavy equipment such as bulldozers, is used to supplement the pick and shovel common to other areas. Two other major areas are Ankamooka, also in South Australia, and Lightning Ridge in New South Wales. Opal prices varied, depending on quality, from about $1 per ounce for the lowest grade of crude to $1,200 per ounce for excellent quality. Top grade opal in larger pieces up to 1 ounce in size sold for nearly $3,000 per ounce.

Botswana.—The Orapa mine of the De Beers Botswana Mining Co., (Pty.) Ltd., produced an estimated 2,718,000 carats of diamond from 2,954,000 tons of ore treated or 92 carats per ton treated.[8] Gem stones were about 15% of the yield. Sampling of kimberlite pipes, DK 1 and DK 2, by De Beers was completed but negotiations on further development were still in progress. The Government of Botswana has requested a review of terms for the Orapa mine.[9] Drilling was continued in several kimberlite pipes in southern Botswana.

Brazil.—The only large mechanical operation, Mineração Tejucana, S. A., reported production of 65,861 carats of diamond from 8.6 million cubic yards of gravel dredged and treated during 1973. Average sales price was $33.81 per carat. Production was about equally divided between gem and industrial stones.

The Brazil National Department of Mineral Production published its first bulletin on prices of minerals and metallurgical products for the period of January to March 1974. For precious and semiprecious stones the price list gave a range for the various qualities and median price f.o.b. Rio de Janeiro for diamond, aquamarine, emerald, chrysoberyl, citrine, amethyst, topaz, morganite, kunzite, garnet, opal, alexandrite, and tourmaline.

Central African Republic.—The 1974 diamond production attained a level about one-fifth higher than that of 1973. About two-thirds of the output was gem stone diamond by weight; and by value, gem stone diamond was more than 90%. Diamond exports accounted for about 35% of the foreign exchange receipts. Société Centrafricaine d'Exploitation Diamantifére was formed as a joint enterprise in 1973 by Diamond Distributors International, Inc., of New York, Cominco, Ltd., of Canada, and the Government to mechanize mining operations as well as to aid diggers. The joint enterprise was credited with the gains for 1974.

Ghana.—The Ghana Department of Mines reported diamond production of 2.3 million carats in 1973, a decline from

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[6] Curtis, R. Sapphire Treasure Won From Australian Open-Cut Mine. Lapidary Journal, v. 28, No. 8, November 1974, pp. 1280–1282.

Kovac, C. Queensland's Sapphires. Lapidary Journal, v. 28, No. 8, November 1974, pp. 1318–1321.

[7] Wright, D. The Craze for Opal. Lapidary Journal, v. 27, No. 11, February 1974, pp. 1726–1732.

Ross, R. Lightning Ridge Block Opal Knobby. Lapidary Journal, v. 27, No. 12, March 1974, pp. 1796–1802.

Oakley, P. An Opal Prospecting Tour Through Australia. Lapidary Journal, v. 28, No. 5, August 1974, pp. 778–789.

[8] De Beers Consolidated Mines Limited. Annual Report 1974, p. 22.

[9] Page 5 of work cited in footnote 8.

Table 3.—Diamond (natural): World production by country[1]

(Thousand carats)

Country	1972 Gem	1972 Industrial	1972 Total	1973 Gem	1973 Industrial	1973 Total	1974[p] Gem	1974[p] Industrial	1974[p] Total
Africa:									
Angola	1,616	539	2,155	1,594	581	2,125	1,600	500	[e] 2,100
Botswana	360	2,043	2,403	362	2,054	2,416	408	2,310	2,718
Central African Republic	346	178	524	251	129	380	300	150	[e] 450
Ghana	266	2,393	2,659	282	2,035	2,317	257	2,316	[e] 2,573
Guinea[e]	25	55	80	25	55	80	25	55	80
Ivory Coast	134	200	334	120	180	300	130	190	[e] 320
Lesotho[2]	1	8	9	1	[r] 8	9	2	9	11
Liberia[3]	[4] 481	[4] 409	[4] 890	[r] 509	[r] 308	[r] 817	377	259	636
Sierra Leone[3]	720	1,080	1,800	646	758	1,404	670	1,000	[e] 1,670
South Africa, Republic of:									
Premier mine	613	1,841	2,454	625	1,876	2,501	605	1,817	2,422
Other de Beers Co.[5]	2,291	[r] 1,874	[r] 4,165	2,368	1,938	4,306	2,397	1,961	4,358
Other	466	[r] 310	[r] 776	455	303	758	433	289	722
Total	3,370	4,025	7,395	3,448	4,117	7,565	3,435	4,067	7,502
South West Africa, Territory of	1,516	80	1,596	1,520	80	1,600	1,491	79	1,570
Tanzania	326	[r] 326	[r] 652	[r] 251	[r] 250	[r] 501	275	275	[e] 550
Zaire	[r] 1,332	[r] 12,058	13,390	[r] 1,082	[r] 11,858	12,940	1,100	11,900	[e] 13,000
Other areas:									
Brazil[e]	155	155	310	160	160	320	160	160	320
Guyana	20	29	49	[r] 31	[r] 21	52	30	20	50
India	17	3	20	18	3	21	17	3	[e] 20
Indonesia[e]	12	3	15	12	3	15	12	3	15
U.S.S.R.[e]	1,850	7,350	9,200	1,900	7,600	9,500	1,950	7,850	9,800
Venezuela	141	315	456	[r] 315	[r] 463	[r] 778	280	420	700
World total	12,688	31,249	43,937	12,477	30,663	43,140	12,519	31,566	44,085

[e] Estimate. [p] Preliminary. [r] Revised.

[1] Total (gem plus industrial) diamond output for each country is actually reported except where indicated by footnote to be an estimate. In contrast, the detailed separate reporting of gem diamond and industrial diamond represents Bureau of Mines estimates in the case of every country except Central African Republic (1972 and 1973), Lesotho (1972 and 1973), Liberia (all years), Guyana (1972 and 1973), and Venezuela (1972 and 1973), where sources give both total output and detail. The estimated distribution of total output between gem and industrial diamond is conjectural in the case of a number of countries, based on unofficial information of varying reliability.

[2] Exports of diamond originating in Lesotho; excludes stones imported for cutting and subsequently reexported.

[3] Exports.

[4] Revised from data in previous edition, which were for years ending August 31 of year stated, to normal calendar year basis.

[5] All company output from the Republic of South Africa except for that from the Premier mine; also excludes company output from the Territory of South West Africa and Botswana.

the 2.7 carats produced in 1972.[10] Since 1968, the average annual production from Ghana's two diamondiferous areas, the Birim River Basin (Eastern Region) and the Bonsa Region (Western), has averaged 2.47 million carats. Three companies, Ghana Consolidated Diamonds, Ltd., Cayco (Ghana) Ltd., and the Amalgamated Diamond Corp., are actively engaged in mining diamonds in the Birim River Basin. First International Natura Corp. of the United States completed exploration in the Birim and Pra River areas, and it was reported the firm would be issued a license for a project in which the Government will own a 55% share. Since the liquidation in 1969 of Takrowase Diamond Field, the Government has preferred participation rather than outright ownership in diamond mining operations. Effective from October 1, 1972, the Government acquired by decree a 55% interest in Consolidated African Trust's Ghana diamond operations by forming Ghana Consolidated Diamonds Ltd., in which Consolidated African Selection Trust Ltd. has a 45% share. Ghana Consolidated Diamonds Ltd. production in the 5-year period, 1968–73, was 2.39 million carats, or about 96% of the country's production, according to Ghana's Mines Department. The output averages about 10% gem stones of high quality.

Kenya.—A pink corundum deposit was claimed to be possibly the largest ruby mine in the world and was also the subject of dispute between Government administrators and geologists from the United States who made the original discovery.[11] According to the reports, about 300 kilograms of corundum were exported in the first 9 months of 1974 and were worth between $30,000 and $40,000 or over $100 per kilogram. The mine is located in the Tsavo National Game Park in southeastern Kenya.

Lesotho.—On March 1, 1974, an announcement was made that De Beers Diamond Corp. and the Government of Lesotho (GOL) reached an agreement in principle on opening the Letseng-la-terai diamond mine in the Maluti mountains at an estimated cost of over $30 million.[12] The agreement was to be signed early in 1975.[13] GOL will have a 25% equity in the corporation and will receive 62.5% of profits after recovery of invested capital. If the mine were to prove substantially more profitable than anticipated, the GOL percentage of profits could rise on a sliding scale to a maximum of 72%. Production is expected to start in 1977 at a rate of 4,000 tons of ore per day. A diamond sales company registered in Lesotho will be established and, throughout the life of the mine, the production will be marketed through the Central Selling Organization.

South Africa, Republic of.—In April 1974 a miner found a 616-carat gem diamond in the crusher at the Dutoitspan mine in the Kimberley area.[14] The diamond is the ninth largest gem diamond ever found and is the largest found in the Kimberley area. The announcement by De Beers said that the diamond was a yellow octahedron of good shape but not of the best quality.

Diamond sales by the Central Selling Organization decreased from R921 million ($1,289.4 million) in 1973 to R849 million ($1,288.6 million) in 1974, or 7.8%. Production of the larger and more valuable stones from all mines, old and new, declined. Generally, the increased demand for small diamonds was insufficient to offset the drop in value due to lower sales of large diamonds.

Sri Lanka.—The State Gem Corporation established a gem export incentive program under which exporters could reserve 25% of their gem value in unrestricted external accounts. The program created a boom in gem stone mining because all other segments of the business population, in addition to those already in the gem stone industry, joined in the export market to have access to the trade privileges. Gem stones in 1973 ranked fourth after tea, rubber, and coconut products in value of exports and were expected to rank second in 1974, exceeded only by the value of tea. Prior to 1973, gem stones contributed little to the total export value of Sri Lanka, but the 20-fold increase of the value in 1973 compared with that of 1972 raised the value of gem stones into the top rankings. Gem stones of interest to collectors include sapphire, ruby, garnet, catseye, spinel, moonstone, alexandrite, tourmaline, and varieties of quartz.

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[10] U.S. Bureau of Mines. Diamond: Ghana. Mineral Trade Notes, v. 71, No. 7, July 1974, pp. 3–4.

[11] Arkansas Gazette. Americans, Kenya Seeking Ruby Mine. Oct. 7, 1974, sec. A, p. 8.

[12] U.S. Bureau of Mines. Diamond: Lesotho. Mineral Trade Notes, v. 71, No. 5, May 1974, p. 3.

[13] Pages 5 and 6 of work cited in footnote 8.

[14] World Mining. Republic of South Africa. Diamonds Sparkle Again for DeBeers. V. 27, No. 6, June 1974, p. 52.

Thailand.—Major gem stones mines in Thailand are located in the provinces of Chantaburi, Kanchanburi, Phrae, Si Saket, and Trat.[15] The following types of gem stones are found: Ruby, sapphire, spinel, peridot, garnet, zircon, beryl, tourmaline, jadeite, quartz, and occasionally diamond. A high-volume of jade and rough sapphire stones are imported and reexported as cut stones because of the lower labor costs in Thailand. The majority, about 85%, of Thai gems are sold as cut stones. In Bangkok, the average prices for cut stones late in 1973 were $500 per carat for ruby, $380 per carat for blue sapphire, and $70 per carat for yellow sapphire. In 1957 gem stone exports amounted to about $380,000 but in 1973 the total value was about $31.0 million.

TECHNOLOGY

The world's third largest rough diamond—the 968.9-carat Star of Sierra Leone—was cut into 11 fine white gem stones ranging from 143.2 carats to 1.85 carats.[16] The total weight of the cut stones was 328.14 carats, a recovery of 33.9% comparing favorably with previously cut large stones.

Two color-illustrated articles described in detail the effects of either gamma radiation or heat treatment on the resulting gem stone colors.[17]

Colorless to pale-yellow topaz turned to a sherry color (imperial topaz) or to brown; however, an occasional topaz turned blue when irradiation was followed by heating. When colorless quartz was gamma-irradiated, it had a smoky or amethyst color, depending on the iron and aluminum content as well as the growth direction. Some natural colorless or pale-color beryl turned a deep-blue color after radiation, but the color was unstable on exposure to light. Similar dosages of gamma irradiation induced major color changes in tourmaline, but the stability of these colors was unpredictable on exposure to light or heat. An unstable new color in some Brazilian crystalline quartz was produced by gamma irradiation followed by gentle heating techniques. Pearls, a gem stone material, turned gray, bluish-gray, or blue by gamma irradiation and were stable. Kunzite turned a deep green after gamma irradiation but bleached on exposure to light or after heating. Minor color changes apparently were produced in jade and no changes appeared in opal after irradiation.

Technological progress in the use and application of lasers and grasers (X-ray laser) in gem stone analyses was reported.[18] Items of significant progress were as follows:

1. High-output laser systems have processed a variety of materials including plastic, metal, stone, and minerals.
2. Laser interferometry, holography, and acoustical holography have been used for the nondestructive testing of materials.
3. The X-ray laser or graser has been used in research and may lead to knowledge of the molecular structure of matter but it is extremely dangerous to use.

The first International Kimberlite Conference was held in the Republic of South Africa and Lesotho September 17 through October 8, 1973.[19] The conference of about 200 delegates from 20 countries brought together geologists who have an interest in the discovery of kimberlites, which can be the source rock for diamond.

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[15] Bangkok Bank Monthly Review. Other Aspects of the Economy. Gem Stones—A Promising Industry. V. 16, No. 3, March 1975, pp. 172–176.

[16] Jewelers' Circular-Keystone. The Diamond Scene. Winston Cuts Sierra Leone Star, Largest Gem Is 143.2 Carats. V. 154, No. 4, January 1975, p. 138.

[17] Nassau, K. The Effects of Gamma Rays on the Color of Beryl, Smoky Quartz, Amethyst and Topaz. Lapidary Journal, v. 28, No. 1, April 1974, pp. 20–26, 30, 36–40.

Nassau, K. The Effect of Gamma Rays on Tourmaline, Greenish-Yellow Quartz, Pearls, Kunzite, and Jade. Lapidary Journal, v. 28, No. 7, October 1974, pp. 1064–1074, 1084.

[18] Goldman, L. Progress in Laser Technology and Art. Lapidary Journal, v. 28, No. 4, July 1974, pp. 636–639.

[19] Boyd, F. R. Kimberlite Conference in Africa. Geotimes, v. 19, No. 5, May 1974, pp. 24–25.

The eruption of kimberlites in various parts of the world has brought an unusual variety of rock to the surface from the upper mantle and crustal basement. Southern Africa is rich in kimberlites, and the kimberlite occurrences in the small country of Lesotho alone amount to 17 pipes, 21 dike enlargements, and more than 200 dikes.[20]

A guide to collecting in working and abandoned mines was published and strongly emphasized attention to safety.[21] The publication was directed towards the experienced mineral collector who occasionally has the opportunity to go underground.

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[20] Lesotho National Development Corp. Lesotho Kimberlites, ed. by P. H. Nixon. Printed by Cape & Transvaal Printers, Ltd., Capetown, Republic of South Africa, 1973, 336 pp., 69 plates.

[21] Wilson, W. E. A Guide to Underground Collecting. The Mineralogical Record, v. 5, No. 3, May–June 1974, pp. 128–137.

Gold

By J. M. West [1]

The price of gold on the open market reached an alltime high, approaching $200 per troy ounce for a brief interval at the end of 1974. Selling prices in New York averaged $159.74 per ounce, 63% higher than the 1973 average. The official gold price, at which Government gold was valued, remained at $42.22 per ounce. Prices were influenced by the expectation that the U.S. Government would remove restrictions on gold ownership by its citizens. A law permitting private ownership was passed in August 1974 and this provision of the law became effective on December 31, 1974. The upswing in prices was limited by several factors: Uncertainties about the levels of demand of the newly created private sector at yearend; declining commercial demand owing to recession; the announcement in December that 2 million ounces of Treasury gold would be offered for public sale on January 6, 1975; sharply increasing imports of gold coins (important restrictions were removed in December 1973); and the introduction of gold futures trading at yearend, which tended to substitute for direct purchase and physical acquisition of the metal.

Supplies of gold to U.S. markets were supplemented by sales of foreign Government-owned gold from stocks on deposit at the Federal Reserve Bank in New York. Sales amounted to 2.14 million ounces in 1974, up 0.45 million over those in 1973. Gold coin imports were estimated to have totaled 3.09 million ounces valued at $552 million. Total gold imports were down 31% in 1974, to 2.65 million ounces, but imports in unrefined form were up 40% to 0.33 million ounces. Domestic mine production declined for the fourth straight year to 1.13 million ounces, a 4% drop. The leading producer was once again the Homestake mine, a deep underground operation of the Homestake Mining Co. in Lead, S. Dak. This also made South Dakota the leading State in gold output. Nevada, with the Carlin and Cortez mines supplying most of the State total, was second and Utah, third. The three States accounted for 80% of total mine production.

Domestic demand for gold dropped 31% in 1974, with jewelry and arts accounting for 52%; dental, 11%; and other uses (mainly electronic), 37% of the total consumed. Inventories of gold in refiners', dealers', and manufacturers' hands declined 178,000 ounces (4%) during the year until December when an estimated 1.35 million ounces was acquired by dealers to meet anticipated new demands after ownership restrictions were rescinded.

Elaborate plans were made by fabricators and dealers to market new gold products in many forms, weights, and varieties of packaging directed toward investment purchases. New sales arrangements were made between traditional suppliers and dealers, some of whom had little previous experience in selling gold. "Certificate plans" were introduced for installment purchases, and estimates of 1975 gold demand for private holding were reported variously but generally between 5 and 15 million ounces. At yearend, five new futures exchanges for gold opened, two in New York and the others in Chicago.

World gold supplies declined, with production down 7.5% to 39.8 million ounces. The Republic of South Africa produced 61% of the world total in 1974, its production dropping 11% compared with 1973 output. U.S.S.R. production was significantly higher in 1974 and accounted for 18% of world output. Canada ranked third and the United States, fourth.

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[1] Physical scientist, Division of Nonferrous Metals.

Samuel Montagu & Co. Ltd., in its Annual Bullion Review 1974, estimated new gold supplies for the year, in million ounces, as follows: From new production (excluding U.S.S.R.), 32; U.S.S.R. sales, 7.4; and other sources, 5.6. Distribution of the "offtake" was reported, as follows, in million ounces: Europe, 15.1; United States, 7.7; Far East, 3.7; Middle East, 1.1; Latin America, 1.3; rest of world, 1.1; and additional amounts to investors, 15.0. Total supply and demand was estimated at 45 million ounces, 55% from the Republic of South Africa and 16% from the U.S.S.R. World consumption of gold in jewelry was estimated to have declined 40% in 1974 but this was offset by a five-fold increase in sales of gold coin, particularly in Europe and the United States. European industrial consumption was down 42%, to 8 million ounces. Demand for private holding and investment was estimated to have increased sharply to 27.3 million ounces; 8.3 million ounces of this was estimated to have gone into the manufacture of gold coins (Republic of South Africa, 35%; Austria, 26%; Mexico, 23%; Hungary, 6%; United Kingdom, 5%). Because of booming coin markets, the Republic of South Africa announced its coinage of the Krugerrand, containing 1 troy ounce of gold, would be expanded to a rate of 150,000 per week early in 1975, which would consume nearly 30% of the country's mine production of gold. Krugerrand sales in 1974 were 3.2 million, including 1.1 million to West Germany, 0.9 million to the United Kingdom, and 0.7 to Switzerland.

Table 1.—Salient gold statistics

	1970	1971	1972	1973	1974
United States:					
Mine production thousand troy ounces	1,743	1,495	1,450	1,176	1,127
Value thousands	$63,439	$61,673	$84,967	$115,000	$180,009
Ore (dry and siliceous) produced:					
Gold ore thousand short tons	3,687	3,471	3,316	4,715	4,598
Gold-silver ore do	214	167	173	124	65
Silver ore do	719	574	355	370	560
Percentage derived from:					
Dry and siliceous ores	61	60	58	52	58
Base-metal ores	37	39	41	47	41
Placers	2	1	1	1	1
Refinery production [1] thousand troy ounces	1,750	1,437	1,478	r 1,210	1,021
Exports [3] do	1,074	1,339	1,472	2,985	3,863
Imports, general [2] do	6,652	7,201	6,126	3,845	2,651
Stocks Dec. 31:					
Monetary [3] millions	$11,072	$10,206	$10,487	$11,652	$11,652
Industrial thousand troy ounces	3,984	4,375	4,407	4,498	5,670
Consumption in industry and the arts do	5,973	6,933	7,285	6,729	4,651
Price: [4] Average per troy ounce	$36.41	$41.25	$58.60	$97.81	$159.74
World:					
Production thousand troy ounces	47,522	46,495	r 44,843	r 42,998	39,780
Official reserves [5] millions	$41,275	$44,742	$45,000	$49,850	$49,795

r Revised.

[1] From domestic ores—U.S. Department of the Treasury.

[2] Excludes coinage.

[3] Includes gold in Exchange Stabilization Fund.

[4] Engelhard selling quotations.

[5] Held by central banks and governments in market economies; gold valued at $35 per troy ounce in 1970, $38 per ounce in 1971–72, and $42.22 per ounce in 1973–74.

Energy consumed in producing gold.—Results of a Bureau of Mines survey of energy requirements in gold mining (1973) completed in 1974 showed that on a per ounce of gold basis placer mining consumed nearly 4 times the energy consumed in lode gold mining. The relatively high consumption in placer operations was generally attributed to the necessity to move large quantities of materials by mechanical means at existing mining localities. A total of 218 reporting gold mine operators consumed 154.2 million kilowatt-hours of electricity (purchased), 2.3 million cubic feet of natural gas, and petroleum products, as follows, in thousand gallons: Heavy fuel, 17; diesel and light fuels, 2,168; gasoline, 514; and other, 26. Generally, about two-thirds of the energy was consumed in mining; one-third went to related smelting, beneficiation, and other purposes. Explosives for mining and energy needed for refining were not considered in the survey.

Legislation and Government Programs.—Public Law 93-373, enacted August 14, 1974, provided for removal of restrictions on U.S. citizens buying, holding, and selling gold. The pertinent section of the Act read as follows:

> Sec. 2. Subsections 3 (b) and (c) of Public Law 93-110 (87 Stat. 352) are repealed and in lieu thereof add the following:
>
> "(b) No provision of any law in effect on the date of enactment of this Act, and no rule, regulation, or order in effect on the date subsections (a) and (b) become effective may be construed to prohibit any person from purchasing, holding, selling, or otherwise dealing with gold in the United States or abroad.
>
> "(c) The provisions of subsections (a) and (b) of this section shall take effect either on December 31, 1974, or at any time prior to such date that the President finds and reports to Congress that international monetary reform shall have proceeded to the point where elimination of regulations on private ownership of gold will not adversely affect the United States' international monetary position."

Restrictions were removed accordingly on December 31, 1974.

In anticipation of the public interest in purchasing gold, the Securities Exchange Commission (SEC) issued release No. 11125 on December 9, entitled "SEC Statement On Gold Ownership," which provided advice on purchasing gold and to whom complaints of deceptive practices should be directed. Copies were available from the SEC, Publications Section, 500 North Capitol Street, N.W., Washington, D.C. 20549.

Section 217 of Public Law 93-463, enacted October 23, 1974, provided for regulation by the newly established Commodity Futures Trading Commission of transactions for the delivery of silver bullion, gold bullion, or bulk silver and gold coins pursuant to a standardized contract. Under the section, effective April 21, 1975, all persons would be forbidden to offer to enter into or confirm the execution of any contract contrary to any rule, regulation, or order of the Commodity Futures Trading Commission.

The Secretary of the Treasury, by Treasury Department Order No. 234, dated December 18, 1974, authorized the public sale of 2 million fine troy ounces of gold on January 6, 1975. The sale was conducted by the General Services Administration's Office of Stockpile Disposal and carried out by sealed bids accompanied by a 5% deposit. The minimum bid was placed at 400 fine troy ounces, and the Government reserved the right to reject any and all bids.

As in previous years, the Office of Minerals Exploration, U.S. Geological Survey, conducted its program of participatory loans for domestic gold exploration projects, providing up to 75% of approved costs for a few qualifying operators.

DOMESTIC PRODUCTION

Reduced domestic gold production during the year resulted partly from declining byproduct gold output at copper mines and from lower output at the Homestake mine in South Dakota. Nevada output, however, was 15% higher than in 1973 owing to increased recoveries from leaching and milling operations of Cortez Gold Mines in Lander County and from expanded activities of Carlin Gold Mining Co. in Eureka County. Production declined at the Knob Hill mine in Washington owing to nearly depleted ore reserves. In Alaska, an increasing number of placer operations contributed to production.

In many gold mining areas of the country, there were reports of renewed gold prospecting and development activities, with plans revealed for significant investments in new production facilities. States with the greatest activity were Nevada, Colorado, California, Alaska, New Mexico, Idaho, and Montana, about in that order. Others included Utah, South Dakota, Oregon, Washington, Arizona, Georgia, and North Carolina. Projects with potential for producing 580,000 ounces of gold per year were expected to come into production in the 1975–77 period.[8]

The four leading U.S. gold producers provided 75% of total production in 1974; 97% of all production came from 25 mines, only 6 of which were operated primarily for gold. Placers contributed only about 1% of production, as in 1973, but the number of placer mines reported decreased to 43 compared with 71 in 1973. The largest placer producer was UV Industries, Inc., operating a bucketline dredge at Hogatza, Alaska. Part of the placer output continued to come from sand and gravel operators in California and Colorado. About 41% of total gold production was a byproduct of other mining.

An estimated 1.9 million ounces of secondary gold was produced by refiners, compared with 1.8 million ounces in 1973. Amax, Inc., with refining facilities at Carteret, N.J., continued as the largest U.S. refiner of gold, reporting output of 973,300 ounces in 1974, mostly produced under toll agreements. Production was 19% higher than in 1973. Kennecott Copper Corp. reported refinery production of 280,561 ounces in 1974 versus 342,284 ounces in 1973.

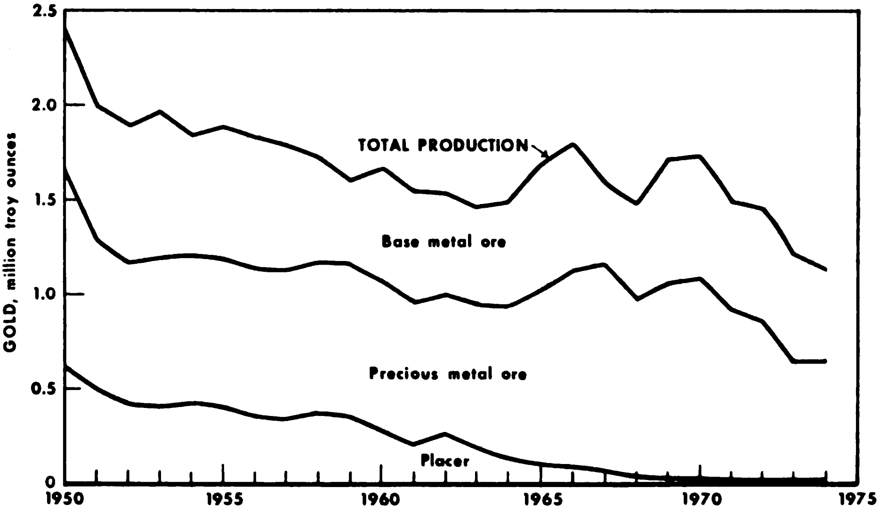

Figure 1.—Sources of U.S. gold production.

Homestake Mining Co. reported a 4% drop in production to 343,650 ounces. The average price received on sales was $157.96 per ounce compared with $93.36 in 1973. Revenues from sales from the Homestake mine were $47.9 million versus $32.9 million in 1973. The average recovered grade of ore was 0.220 ounce per ton compared with 0.227 ounce per ton in 1973, a 3% drop. A total of 1.56 million tons of ore was milled, slightly less than in 1973 but metallurgical recovery was improved to an average 95.12% compared with 93.63% in 1973. A reduced supply of miners continued to limit tonnages mined. Work began on deepening the No. 6 winze and advanced 517 feet to a depth of 7,729 feet below surface by yearend. Sinking of the No. 7 winze from the 6,800-foot level was expected to start by mid-1975. The winzes will provide access to the 8,000-foot level. Exploration crosscuts were driven toward the western parts of the mine. Ore reserves at yearend were estimated at 15.45 million tons averaging 0.262 ounce per ton compared with 15.87 million tons averaging 0.280 ounce per ton a year earlier; 57% was classified as proven ore. Company employment was 1,600 in total, of which 1,067 employees were in the mining department.

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[8] Melbye, C. E. New U.S. Discoveries and Expected Mine Production. Paper pres. at 1975 Internat. Monetary Symp., Miami Beach, Fla. Jan. 7, 1975. (Copies available from Minerals Engineering Co., Denver, Colo.).

At the Carlin mine in Nevada, 160,500 ounces of gold was produced, 7% more than in 1973. Sales were valued at $26.5 million compared with $15.0 million in 1973; net income from the Carlin operations rose 93%, to $10.9 million. The grade of ore averaged 7% higher in 1974 than in 1973, at 0.223 ounce per ton and slightly less ore, 824,000 tons, was milled. The total tonnage of material mined was 6.27 million tons including waste from stripping. Minable ore reserves at yearend were 4.18 million tons, averaging 0.233 ounce per ton (including Bootstrap and Blue Star mines), and an additional 0.99 million tons of somewhat higher grade ore was revealed by drilling the flanks of the existing Carlin pit area. Exploration continued on deeper portions of the Carlin deposit in ores with a relatively high-carbon content, generally more costly to mill. Mining began at the Bootstrap and Blue Star properties, where reserves totaled 2.1 million tons averaging 0.15 ounce per ton, which were destined for the Carlin mill. Also, the properties contained 0.5 million tons of 0.02 to 0.04 ounce grade to be subjected to heap-leach extraction.

Mining continued at Cortez Gold Mines Gold Acres property and, with higher prices, was resumed at the Cortez open pit mine in Nevada, but reserves were estimated only sufficient to sustain milling until mid-1975. During 1974, 853,500 tons of ore was milled averaging 0.116 ounce per ton, with recovery of 81.8%. Milling provided 81,200 ounces of gold versus 65,400 ounces in 1973, and heap-leaching provided 23,100 ounces versus 10,300 ounces in 1973. About 4 million tons of heap-leachable material was under treatment, with recoveries estimated to date of 64% at Cortez and 50% at Gold Acres. Further exploration was in progress at Gold Acres.

All assets in Alaskan gold operations of UV Industries, Inc. were exchanged for stock in a wholly owned subsidiary, Alaska Gold Co., as of January 1, 1975. The firm continued to operate a gold dredge at Hogatza and prepared to renew dredge operations in the Nome area of Alaska in 1975. Gold reserves in the Nome area were estimated at 1.19 million ounces, including 66,400 ounces added in recent drilling. An additional 78,800-ounce reserve was estimated from recent exploration 5 miles west of Nome. Thawing of frozen ground continued in advance of dredging.

Among developments in 1974, the Ajax shaft of the Golden Cycle Gold Corp. near Cripple Creek, Colo., was sunk to the 3,350-foot level and mill reconstruction was in progress. Test work was completed by other companies on heap-leaching projects at Round Mountain and Manhattan, Nev., and production scale operations were scheduled. A bucket-line dredge was scheduled to renew operations early in 1975 at Hammonton, Calif. Studies were progressing on significant new cyanidation projects at the Getchell mine, Humboldt County, Nev.; the Pinson-Prebel mine, also in Humboldt County; portions of the Comstock Lode, Storey County, Nev.; the Delamar mine, Owyhee County, Idaho; and the Golden Sunlight mine, Jefferson County, Mont. The Atlanta gold-silver mine, in Lincoln County, Nev., was scheduled to return to production in April 1975 at an annual rate of 13,500 ounces of gold and 65,000 ounces of silver. The mine will be operated by Standard Slag Corp. and will be worked by open pit methods.

CONSUMPTION AND USES

U.S. gold consumption, based on estimated net purchases of gold by U.S. industry, reported by the Office of Domestic Gold and Silver Operations, U.S. Department of the Treasury, was 4.65 million ounces, 31% lower than in 1973. Purchases were divided by industrial groups, as follows, in thousand ounces (with 1973 figures for comparison): Jewelry and arts, 2,402 (3,473); dental, 509 (679); and industrial, including space and defense, 1,740 (2,577). All categories were lower owing to the recession. About 48% of total purchases were made in the first half of the year and 52% in the last half. Excluded from the statistics was an estimated 1.35 million ounces required by refiners and dealers in December 1974 to meet expected demand by individuals following the end of ownership restrictions.

In addition to bullion consumption, U.S. buyers purchased an estimated 3.09 million ounces of imported gold coins in 1974, much higher than in 1973. The value of these coins was reported at $552 million during 1974, 39% marketed in the first half and 61% in the second half of the year.

Owing to higher prices for gold, there were increased efforts to substitute less expensive metals and to apply gold to products only where specifically necessary. In jewelry, more sales of heavy plated gold were reported and less of karat gold, which is more expensive and contains much more gold. Silver jewelry sales were reportedly making inroads on gold jewelry sales because of changes in buyers attitudes and the introduction of new silver jewelry items. Use of clad metal inlays for electronic connections was expanding, with increased knowledge of physical and electrical properties of various alloys.[3] Potential for a sharp drop in contact consumption of gold was foreseen. Substitution of low-gold and nickel-based alloys for 82% gold-18% nickel alloys commonly used in high-temperature brazing was under study.[4]

Use of thin gold films on window panes as protection from solar radiation and to reduce fuel costs was described.[5] The gold was applied by vacuum-film methods; sheets up to 100 square feet in area were treated, with glass available in various shades of blue, gold, and bronze. Gold films were also considered useful in devices converting solar energy, and a significant role for gold was seen in this application.[6]

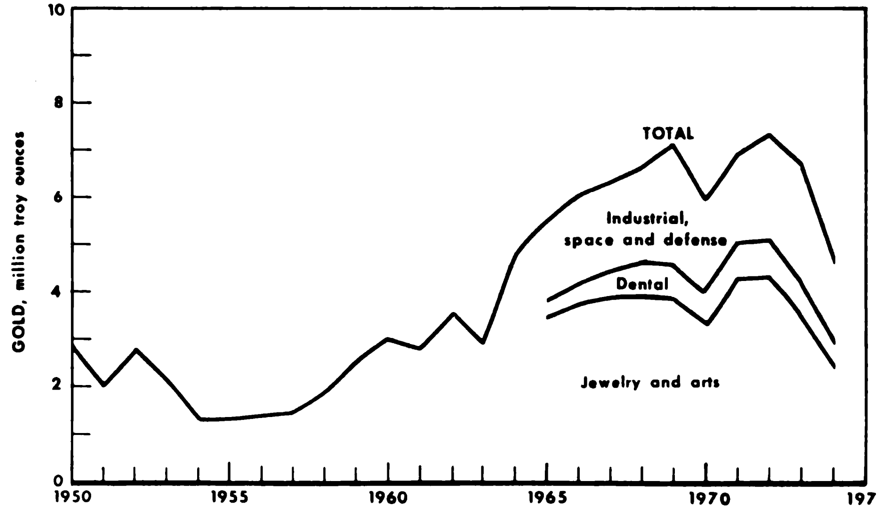

Figure 2.—Gold consumption in the United States.

STOCKS

Monetary.—U.S. official gold stocks (including stocks in the Exchange Stabilization Fund) remained the same all year at 276.0 million ounces valued at $11,652 million ($42.22 per ounce). Inconvertability of dollars to gold remained in effect.

Earmarked gold held in Federal Reserve banks for foreign official accounts was valued at $16,838 million at the end of December, equivalent to 398.8 million ounces, 5.5 million ounces less than at the end of December 1973.

Total gold reserves of all central banks and governments (excluding those of centrally planned economies) were estimated by the Federal Reserve Bank at $49,795 million in value at yearend 1974 compared with $49,850 million a year earlier. The major countries or institutions holding stocks, with equivalent million ounces at the end of 1974, were, as follows: The United States, 276.0; International Monetary Fund (IMF), 153.4; Federal Republic of Germany, 117.6; France, 100.9; Switzerland, 83.2; Italy, 82.5; the Netherlands, 54.3; Belgium, 42.2; Portugal, 27.9; Canada, 22.0; Japan, 21.1; the United Kingdom, 21.0; Austria, 20.9; the Republic of South Africa, 18.3; and Spain, 14.3. Stocks totaled 1,179.4 million ounces. South African stocks declined 0.78 million ounces during 1974, partly owing to increased coinage. Mexican stocks declined about 1 million ounces for the same reason. Kuwait and Portugese stocks rose 0.7 and 0.4 million ounces, respectively, during the year. The U.S.S.R. stocks were believed to have remained about the same in 1974 at between 60 and 65 million ounces, with production approximately equaling the sum of consumption and sales.

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[3] Russell, R. J. Properties of Inlay Clad Wrought Gold Alloys. Paper pres. at Connector Symp., Cherry Hill, N.J., Oct. 23, 1974, 15 pp.; available from Tech. Materials, Inc., Providence, R.I.

[4] Thornton, J. GE Tries Substitute for Gold in Jet Engine Brazing. Am. Met. Market, v. 81, No. 74, Apr. 16, 1974, p. 21.

[5] Groth, R., and W. Reichelt. Gold Coated Glass in the Building Industry. Gold Bull., Chamber of Mines of South Africa, v. 7., No. 3, July 1974, pp. 62-68.

[6] Brinkworth, B. J. Gold Films in Solar Energy Utilisation. Gold Bull. v. 7, No. 2, April 1974, pp. 35-38.

Special Drawing Rights (SDR's) holdings for all countries in the IMF were valued at $10,845 million at the end of 1974 compared with $10,625 million a year earlier. The U.S. reserve position in the Fund was $1,852 million at the end of 1974 compared with $552 million a year earlier. The dollar value of an SDR was $1.2243 at the end of 1974 compared with $1.2064 a year earlier. Changes in the value of the SDR after July 1, 1974, were determined from changes in the value of a "basket" of the currencies of 16 countries whose exports in 1968–72 constituted 1% or more of world exports. The new values were determined daily by valuing the currencies in the basket on the basis of their exchange rates on the London Market. Prior to July 1974 the SDR was valued according to the official price of gold and was equivalent to 0.888671 gram of fine gold by definition.

Industrial.—Domestic gold inventories as reported by the Office of Domestic Gold and Silver Operations, U.S. Department of the Treasury, were as follows, in thousand troy ounces at yearend 1974 (with changes from yearend 1973): Refiners, 3,761 (up 28%); dealers, 1,004 (up 113%); and manufacturers, 905 (down 17%). Stocks included an estimated 1.35 million ounces acquired by refiners and dealers in December 1974 to meet expected demand by individuals following the yearend removal of restrictions on private ownership. Total stocks of 5.67 million ounces were 26% higher than at the end of 1973.

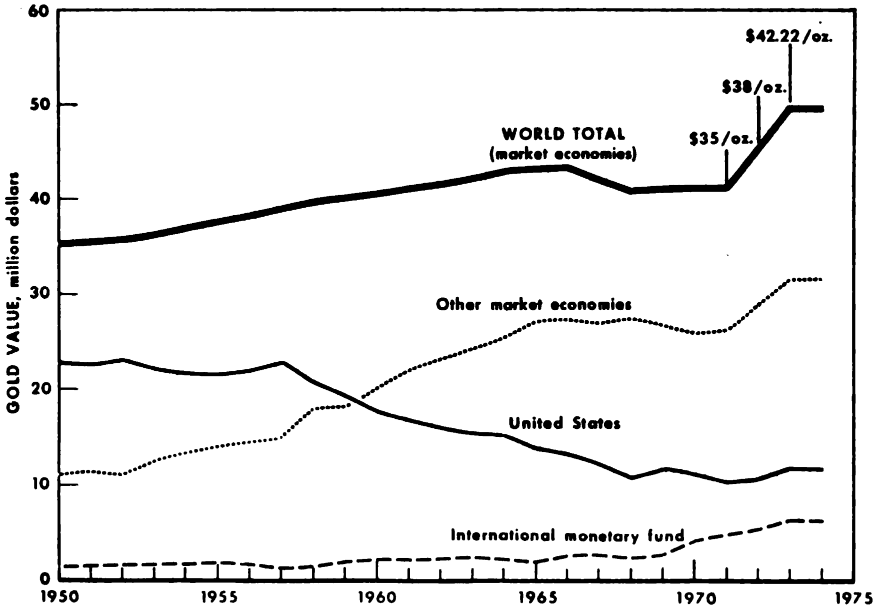

Figure 3.—World monetary gold stocks.

PRICES

Free market gold prices, as quoted daily by Engelhard Industries, rose from a low of $117.00 per troy ounce on January 2 to a high of $194.75 per ounce on December 27 and averaged $159.74 for the year. From December 27 to the end of the year, Engelhard suspended price quotations owing to impending changes in marketing methods planned as a result of removal of restrictions on gold sales. London prices during most of the year were about 50 cents lower than New York prices and the average London final price for the year was $159.259 per ounce. The highest London price was $197.50 at the initial fixing on December 30; the final price that day was $195.25 per ounce. On December 31, the London final price declined to $186.50.

Table 2 shows ranges and average prices for gold by month during 1974. Prices were influenced by a variety of events related to world monetary and economic uncertainties. Towards the end of the year, prices were influenced mainly by speculation that demand for gold would rise sharply as a result of the removal at year-end of restrictions on the holding of gold by U.S. citizens. However, the price rise was limited by the announcement that the U.S. Treasury would offer on an auction basis up to 2 million ounces of gold bullion in early January 1975. Subsequently, only 754,000 ounces of that offered was sold at an average price of $165.67 per ounce. The official gold price in the United States and most other countries remained at $42.22 per troy ounce, the price at which Treasury gold stocks were valued. No gold was bought or sold at this price, however.

Table 2.—U.S. monthly gold selling prices, per ounce

Month	1974		
	Average	Low	High
January	$129.69	$117.00	$141.50
February	150.75	131.00	175.50
March	168.92	159.50	178.00
April	172.81	167.50	180.00
May	163.77	154.50	170.15
June	154.60	144.75	162.25
July	144.11	137.00	158.00
August	155.12	152.00	159.90
September	151.93	145.90	158.25
October	159.29	154.50	168.75
November	182.47	168.20	191.00
December	183.48	174.75	[1] 194.75
Year	159.74	117.00	194.75

[1] No quotations were issued from December 27 to December 31.

Source: Engelhard Industries.

FOREIGN TRADE

U.S. exports of gold in 1974 amounted to 3.86 million ounces valued at $228.5 million. Of the quantity exported, 3.30 million ounces was designated as monetary gold valued at the official rather than market price. Exports of monetary gold included 2.58 million ounces going to Saudi Arabia, 0.35 million ounces to Switzerland, 0.20 million ounces to Mexico, and 0.16 million ounces to Canada. The balance of the gold exported consisted of 0.31 million ounces of scrap and 0.26 million ounces of bullion. Most of the scrap went to Belgium (46%) and the United Kingdom (32%).

Gold imports totaled 2.65 million ounces valued at $396.7 million. Imports consisted of 0.33 million ounces of ore, base bullion, and scrap valued at $46 million and 2.32 million ounces of bullion valued at $350.7 million. Imports were 36% from Canada, 22% from the U.S.S.R., 17% from Switzerland, 6% from France, and 19% from 31 other countries. Average import values for bullion from the leading sources were as follows, per troy ounce: Canada, $150.38; the U.S.S.R., $144.10; Switzerland, $154.25; France, $162.66; the United Kingdom, $158.45; and Yugoslavia, $152.76. In addition to imports, gold markets were supplied with 2.14 million ounces from foreign government stocks stored at the Federal Reserve Bank in New York.

The net inflow of gold to U.S. markets (excluding monetary movements but including supplies from foreign stocks in New York) amounted to 4.23 million ounces in 1974 compared with 4.76 million ounces in 1973. In addition, an estimated 3.09 million ounces of gold was imported into the country in the form of gold coins during 1974. The inflow of unrefined gold was 7% more than the outflow in scrap in 1974.

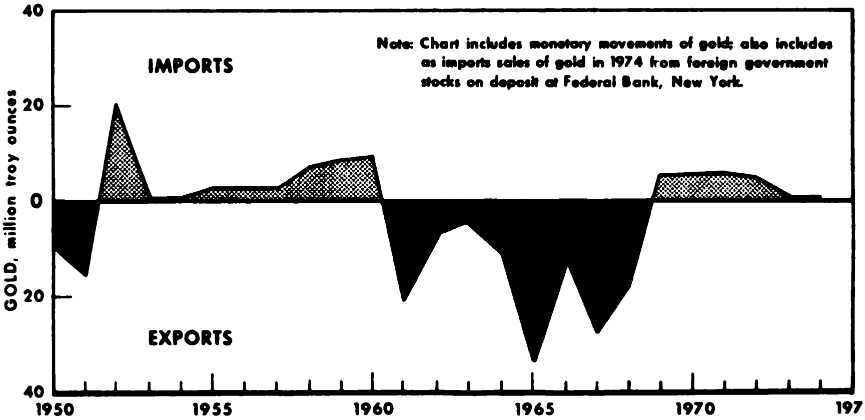

Figure 4.—Net exports or imports of gold.

WORLD REVIEW

Despite higher gold prices, world gold production declined for the fourth year to 39.8 million ounces, a 7.5% drop. The U.S.S.R. showed the only significant increase, with output rising 3%, to 7.3 million ounces, owing mainly to expanded open pit and lode gold mining operations at several large facilities. The Republic of South Africa produced about the same tonnage of ore as in 1973 but 11% lower in grade, hence, that much less gold production. Byproduct gold production was probably slightly higher than in 1973, but copper, the main byproduct source, was in less demand toward yearend 1974, and production cuts were expected to reduce this source of gold in 1975. A significant new producer was expected to come into production in the Dominican Republic early in 1975. Many past producing gold properties throughout the world were being reexamined in view of higher prices and possible utilization of new technology to reduce extraction costs.

World net gold consumption in fabricated products was estimated by Consolidated Gold Fields Ltd. at about 23 million ounces in 1974 compared with 27 million ounces in 1973, down 15%. Although jewelry uses dropped sharply, part of this drop was offset by a large increase in official gold coinage, which rose from 1.7 million ounces in 1973 to an estimated 9.2 million ounces in 1974. Significant increases in coinage took place in the Republic of South Africa, Austria, Mexico, Hungary, and the United Kingdom. Total net private purchases of gold were estimated at 40 million ounces, including 7 million ounces in net trade with the U.S.S.R. Samuel Montagu & Co. Ltd. estimated the world offtake of gold in 1974 at 45 million ounces, including 15 million ounces to investors. Private hoarding probably accounted for 10 to 11 million ounces of the offtake. European industrial consumption was estimated to have fallen 42%, to 8 million ounces, compared with that of 1973, with the sharpest decline in Italy. Gold in the form of scrap jewelry and bars was dishoarded in the Middle East and Far East in amounts estimated to total 4 million ounces in 1974, nearly twice that in 1973. The U.S.S.R. gold sales were estimated at 7.4 million ounces. The total world supply of gold was estimated at 45 million ounces. Mocatta and Goldsmid Ltd. estimated world consumption at 20.3 million ounces (excluding coinage) in 1974, 5.5 million ounces less than in 1973. Investments in coins accounted for an estimated 7.4 million ounces, up from 1.6 million ounces in 1973.

A brief review by countries follows:

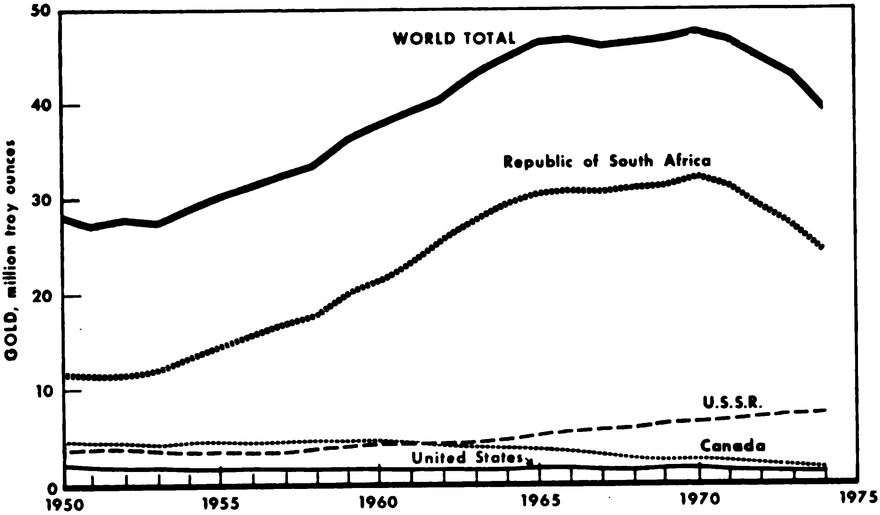

Figure 5.—World production of gold.

Angola.—Plans were announced by Chromalloy American Corp. to begin producing gold on a pilot scale about mid-1974 at its new Angolan property. High-assay values were reported on vein material, and production worth over $100,000 monthly was anticipated for at least 2 years and probably longer.

Argentina.—Yacimientos Mineros Aqua de Dionisio continued work on developing gold-silver-copper manganese deposits at Farallon Negro, Catamarca. Processing of 350 tons of ore per day was planned to produce annually an estimated 20,000 ounces of gold, 81,000 ounces of silver, and 25,000 tons of manganese concentrates.

Australia.—Australian gold production continued to come mainly from several gold lodes in Western Australia, the Kalgoorlie area providing about 432,000 ounces of output in the first 9 months of the year. Newmont Mining Corp. disclosed a feasibility study of its Telfer gold deposits in the Paterson Range of the Great Sandy Desert of Western Australia indicating ore reserves of 3.8 million tons averaging 0.31 ounce per ton which could be mined by an open pit. A tentative production schedule was set at about 200,000 ounces per year by yearend 1976. At Coolgardie, Western Australia, Roebourne Exploration and Mining Ltd. planned a gold mill after favorable feasibility studies. A 0.5-million-ton reserve averaging 0.38 ounce per ton was outlined in diamond drilling by Kia Oro Gold Corp. N.L. and Nickel Exploration Ltd. at the Marvel Loch gold mine near Southern Cross, Western Australia.

Bolivia.—South American Placers Inc. (SAPI) and the Tipuani Cooperatives operated placer mines at Teoponte and sold all production to the Central Bank as required by law. Sales were about the same as in 1973 when 14,187 fine troy ounces of gold was contained in 21,554 ounces of 95% pure placer product. As a result of a tax dispute, SAPI agreed to pay the Bolivian Government 751 troy ounces of gold and relinquished claims on alluvial areas that the firm had no existing plan to exploit. The settlement made possible negotiations to form a new company which will dredge placer deposits contiguous to SAPI's active properties at Teoponte. Camino Gold Mines Ltd. held options on 10,000 acres of placer property in the Tipuani River Valley and conducted sampling by a number of 3-foot-diameter test shafts. A pilot plant processed sample materials at the site.

Brazil.—The entire lode gold production came from operations of Mineracão Morro Velho S.A. in Minas Gerais. In addition there was unrecorded placer production estimated at about 13,000 ounces of gold per month, principally from the Amazon's Tapajos basin, where the Jamanxim River was the single richest area. The Madeira River in Rondônia was also reported promising enough to have attracted the interest of a mining company during the year. Another company was evaluating a mining venture at Guajará-Mirim, near the Bolivian border. Other active placer areas were on the Calcoene and Vila Nova Rivers in Amapá and on the Gurupi River between Pará and Maranhão States.

Canada.—Canadian gold production declined 12%, to 1.72 million ounces in 1974 and output was expected to be lower in 1975. The drop marked the fifteenth year in a row that gold production had declined. Output by Province, with change from 1973 (in parentheses) follows: Ontario, 46% (down 15%); Quebec, 26% (down 10%); Northwest Territories, 11% (down 30%); British Columbia, 11% (down 4%); Prairie Provinces, 4% (down 10%); Yukon, 1% (up 17%); and Atlantic Provinces, 1% (down 5%). Quartz lode and placer deposits provided 73% of total 1974 production; base metal mines supplied the balance. The average grade of ore at the end of 1974 for six gold mines in Quebec was 0.14 ounce per ton, with highest grade 0.18 ounce per ton. At the end of 1974, Canada had 22 mines classified as lode gold mines, the same number as a year earlier. Placer mining accounted for less than 0.5% of the 1974 production and was mostly in Yukon and British Columbia.

In Ontario, 11 lode mines accounted for 93% of Provincial production. Campbell Red Lake Mines Ltd. remained Canada's largest gold producer, yielding 197,369 ounces of gold from 289,833 tons of ore averaging 0.74 ounce of gold per ton in 1974. The main stoping areas were above the 2,200-foot level. During the year, about 21,000 feet of diamond drilling was done increasing ore reserves by 74,000 tons to 1.56 million tons.

Madsen Red Lake Gold Mines Ltd. sold its Red Lake, Ontario, mine and milling facilities to Bulora Corp. for $1.7 million and Bulora planned $0.5 million expenditures for development and exploration. Dickenson Mines Ltd. explored with favorable results at a depth of about 5,000 feet and at midyear had reserves of 346,600 tons averaging 0.46 ounce per ton in the Dickenson mine and 103,900 tons averaging 0.72 ounce per ton in its Robin Red Lake property. Wilmar Mines, Ltd., owned by Cochenour Willans Gold Mines Ltd. and Martin-McNeely Mines Ltd., found a new ore body at its Red Lake property with reserves estimated at 5 million tons averaging 0.15 ounce per ton in gold. A feasibility study was underway for reopening and expanding the Cochenour mill to a 2,000-ton-per-day capacity to handle production.

Nudulama Mines Ltd., controlled by Coniagas Mines Ltd., planned to reopen its mine, idle since 1952 in Lesueur Township, in the Missanaibi area of Ontario. Ore reserves were reported at 579,000 tons averaging 0.194 ounce per ton. Rengold Mines Ltd. leased the Renabie property of Willroy Mines Ltd. and planned extensive exploration. Consolidated Professor Mines Ltd. planned a $1.5 million development program at its Duport gold mine at Shoal Lake, in the Kenora area of northwestern Ontario. A 300-ton-per-day production rate was considered. Pursides Gold Mines Ltd., subsidiary of Ballinderry Explorations Ltd., dewatered its Wawa area gold mine and began exploration. Lakelyn Mines Ltd. planned a 100,000-ton-per-year operation at Lingman Lake based on reserves of about 0.8 million tons grading between 0.21 and 0.41 ounce per ton.

In Quebec, Agnico-Eagle Mines Ltd. produced at a rate of 800 tons per day of ore grading 0.27 ounce per ton from its Joutel gold mine and expected to reach 1,000 tons per day early in 1975 after solving a production problem with its high sulfide ore. Goldex Mines Ltd. completed installing equipment at its Dubuisson Township, Quebec, gold mine. The mine was developed by a 2,400-foot inclined shaft and lateral drifts; ores will be treated at the nearby Malartic Gold Fields Ltd. mill. Camflo Mines Ltd. increased mill capacity to 1,250 tons per day in Northwest Quebec and deepened its shaft to 3,350 feet, adding four production levels. Ore reserves at yearend were about 3 million tons grading 0.19 ounce per ton. Gold Hawk Mines Ltd. reported that its Dasserat, Quebec, property under lease to Somed Mines Ltd., contained reserves of 1.6 million tons grading 0.28 ounce per ton. Somed was reportedly planning to proceed with development and to ship

80,000 tons of ore to the nearby Kerr Addison Mines Ltd.'s mill. Gold Hawk also completed a diamond drill program at Cadillac, Quebec, and planned underground work. Chibex Ltd. began mill operations late in 1974 in the Chibougamau district at a rate of 500 tons per day. Sigma Mines Ltd. milled 498,410 tons of ore in 1974 and recovered 73,019 ounces of gold. Ore reserves were estimated at 1.25 million tons, and a shaft-deepening program was completed adding four new levels at 200-foot intervals from the bottom of the 5,962-foot main shaft.

The number of gold quartz and placer claims in the Yukon Territory rose sharply in 1974, indicating increased prospecting activities. Most placer claims were in the Dawson Mining Division. In the Northwest Territories, Giant Yellowknife Mines Ltd. produced 101,514 ounces of gold from 328,099 tons of ore milled in 1974 and reported yearend ore reserves in its Giant, Lolor, and Supercrest deposits at 2.4 million tons averaging 0.33 ounce per ton. About 10% of the Giant production in 1974 was from an open pit containing an estimated 480,000 tons of ore grading 0.3 ounce per ton. Cominco Ltd. continued sinking a 5,800-foot shaft at its Con property in the Campbell-Giant shear zone and planned additional exploration in the Yellowknife Bay area. Arcadia Explorations Ltd. explored a promising prospect, the Coronation Gulf, near the Western Arctic Ocean, 380 miles north of Yellowknife. In British Columbia, Northair Mines Ltd. planned a 300- to 400-ton-per-day mill at its Brandywine Falls property, 70 miles north of Vancouver, based on an estimated reserve of 400,000 tons averaging 1.05 ounce of gold per ton. The Unicorn gold-silver mine, north of Stewart, British Columbia, was reopened by Tournigan Mining Explorations Ltd. Other gold properties being explored included the Surf Inlet, northwest of Vancouver on Princess Royal Island; the Carolin Mines Ltd. property, northeast of Hope, where 1 million tons of 0.1-ounce-per-ton ore was outlined; the Carolin Mines Ltd. property near Lardner Creek, also northeast of Hope; and the Kalco Valley Mines Ltd. property on the Unuk River, 60 miles north of Stewart, B.C.

Colombia.—Mineros Colombianos S.A., a group of Colombian investors, purchased Cia. Minera Chocó Pacífico, S.A., a gold dredging firm, from International Mining Corp. about the end of May. Purchase of Pato Consolidated Gold Dredging Ltd. was also under consideration. International Mining retained a technical assistance contract with the new owners.

Costa Rica.—Reserves estimated at 70,000 tons averaging 0.44 ounce per ton were reported at the Bellevista-Montezuma gold property of New Taku Mines Ltd. (Canada). A change in the company name was planned to Gold Ventures Ltd., and a 150-ton-per-day mill was expected to be operational by yearend 1974. Bonnacord Explorations Ltd. (Canada) optioned a placer property covering nearly 4 square miles on the Peninsula de Osa and established a base camp for exploration to begin late in 1974.

Dominican Republic.—A large, new gold-silver mine, the Pueblo Viejo, of Rosario Dominicana, S.A. (parents, Rosario Resources Corp. and Simplot Industries, Inc.) was expected to begin production early in 1975 after delays in delivery of equipment. The cyanidation plant will treat 8,000 tons of ore daily producing 350,000 ounces of gold and 1.5 million ounces of silver annually. Reserves of oxide ore are established at 30 million tons averaging 0.128 ounce of gold and 0.82 ounce of silver per ton. Underlying this is a sulfide zone with 17.7 million tons of ore averaging 0.13 ounce gold and 1.12 ounce silver per ton, 2.19% zinc, and 0.25% copper.

El Salvador.—San Sebastian Gold Mines, Inc., planned to increase production at its gold property in the eastern part of El Salvador from 400 to 1,000 ounces per month. Known reserves were reported at 300,000 tons averaging 0.35 ounce per ton; total reserves were placed at 7 million tons grading 0.05 to 0.10 ounce per ton.

Fiji.—Despite a nearly 14% decline in production, Fiji's gold mining was more profitable than in 1973 owing to higher gold prices. Most high-grade ores were exhausted but lower grade ores were estimated adequate for an additional 25 years at existing rates of extraction.

France.—Techniques for treating arsenical gold ores were improved at the Salsigne mine of Mines et Produits Chimiques de Salsigne in the Carcassonne region of central France, increasing ore reserves as a result. Plans to sink a new shaft to a depth of 1,260 feet initially, extending it to 2,200 feet eventually were reported. In 1973, the mine yielded 49,675 ounces of gold, 161,146 ounces of silver, 338 tons of copper, 38 tons of bismuth, 6,630 tons of arsenious trioxide, and 20,000 tons of sulfuric acid. Silver Eureka Corp. (Canada) controls the French company.

Germany, West.—During the first half of 1974, 225,000 ounces of gold was imported from the U.S.S.R. This compared with 289,000 ounces from this source during the first half of 1973.

Honduras.—Alianza Industrial S.A. obtained an option on the Tatumbla gold property and planned test work and rehabilitation. An estimated 225,000 tons grading 0.2 ounce of gold and 0.5 ounce of silver per ton was available to open pit mining.

India.—Gold smuggling into India was expected to decline to about 1 million ounces in 1974 after reaching an estimated 4.5 million ounces in 1972 and 2.5 million ounces in 1973. Bharat Gold Mines Ltd. (Government-owned) operated mines in the Kolar goldfields, while the Karnataka State-owned Hutti Gold Mines Co., Ltd. operated mines in the Hutti area. With the assistance of the Geological Survey of India, Bharat Gold Mines accelerated underground exploration at its Champion Reef and Nundydroog mines and reportedly located new near-surface gold in sulfide ores in the western part of the old Kolar field. Exploration was also underway at Ramgiri, Andhra Pradesh, and at Mamandur, Tamil Nadu. In 1973, Bharat Gold Mines had operated at a loss, with total production costs averaging $156.53 per troy ounce on an output of 57,163 ounces of gold. Losses were partially offset by a $5.3 million subsidy. India's total 1973 ore output was 620,012 short tons averaging 0.17 ounce of gold per ton. Combined ore reserves at Kolar and Hutti remained at 4.6 million tons averaging 0.25 ounce per ton.

Indonesia.—Mining permits were issued for primary gold deposits in the Bogor and Sukabumi areas of West Java and the Solak area of West Sumatra; permits were also issued for placer gold and associated minerals in the Meulaboh area of Aceh and in West, Middle, and East Kalimantan. Most of Indonesia's gold production continued to come from the Tjikotok and Tjirotan mines in West Java.

Japan.—Sumitomo Shoji Kaisha, Ltd. estimated Japanese gold consumption in fiscal year 1973–74 (ending April 1974) at 4.2 million ounces, including 0.8 million ounces going to "private hoarding." Of the remaining 3.4 million ounces, jewelry and industrial art works required, 44%; communication and gilding, 22%; dental and medical uses, 14%; decorations and insignias, 9%; timepieces, 3%; and other uses, 8%. The supply came from imports, 71%; primary production, 26%; and secondary sources, 3%. During the calendar year 1973, imports totaled 3.85 million ounces, 56% from the United Kingdom, 40% from Switzerland, and 4% from eight other countries. Imports were 1.13 million ounces in the first 5 months of 1974.

Mexico.—Silver-gold deposits were under development by Lacanex Mining Corp. (Canada) in the Guanajuato area of Mexico. A silver-gold property in Taviche, Mexico, was being brought into production at a 200-ton-per-day milling rate by several Canadian firms.

Nicaragua.—Rosario Resources Corp. rehabilitated the shaft at the Siuna mine, purchased from La Luz Mines, Ltd., and installed new equipment. Total proven and probable ore reserves at yearend were reported at 10.2 million tons averaging 0.073 ounce of gold per ton. The mine has a 2,000-ton-per-day mill, unused since 1968.

Papua New Guinea.—New Guinea Goldfields, Ltd. operated its Golden Ridges mill at 7,000 tons per month in early 1974, yielding 312 fine ounces of gold and 254 ounces of silver. Production was down owing to a metallurgical problem.

Peru.—Peru sold about 21,000 ounces of gold bullion in May 1974 through the Bank of Nova Scotia (Canada). Most of the country's gold continued to come from the Cerro de Pasco smelter at La Oroya but increasing amounts came from small-scale placer mining with encouragement of the Banco Minero del Peru.

Philippines.—Benguet Consolidated Inc. produced about 135,000 ounces of gold in 1974 compared with 180,000 ounces in 1973. Production was from two mines, the Acupan and Antamok, in Mountain Province, 150 miles north of Manila on Luzon. During the year there was a substantial increase in ore reserves at the Acupan mine; plans for block-caving were considered for the Antamok mine as part of a 3-year development program. Company reserves were about 2 million tons of ore at yearend. A gold placer mining venture was planned by Golden River Mining Corp. in Paracale, Camarines Norte, where it was estimated 2 million yards of material contained 13,000 ounces of 850 fine gold. Also, in the same area Metals Exploration N.L. drilled the Longes gold lode and estimated reserves at 0.6 million tons averaging about 0.8 ounce per ton.

Rhodesia, Southern.—The Rhodesian Mine Ministry was reportedly expecting an additional 74 gold mines to come into production in 1974 following the establishment of 87 new mines in 1973. Presumably, these were relatively small operations.

Sierra Leone.—The Government granted placer gold mining licenses to 9 Sierra Leoneans and declared 17 chiefdoms of the country as gold mining areas subject to the Alluvial Gold Mining Regulations. Districts covered were the Koinadugu, Tonkolili, Bombali, Kailahun, and Kono. A small quantity of gold was produced and exported.

South Africa, Republic of.—South African gold production fell for the fourth consecutive year, declining 11% to 24.4 million ounces. The tonnage of ore milled in 1974 was down less than 1% to 73 million tons; however, the average grade of ore milled declined 11% to 10.19 grams per metric ton (0.30 ounce per short ton). Labor problems intensified during the year and employment was estimated 15% to 20% below normal by yearend. Total underground labor was down to about 274,000. Randfontein Estates Gold Mining Co. Ltd. reopened its old No. 32 shaft and produced from its No. 1 Cooke section shaft beginning in 1974. Capacity in 1975 was expected at 70,000 tons per month and was to double late in 1977 when the No. 2 shaft was to be completed. Only 4 out of 42 active mines increased production tonnages in 1974; the largest increases were at the Western Areas mine (up 21%) and the East Driefontein mine (up 15%).

The West Driefontein mine remained the largest gold producer in the world, with output of 2.28 million ounces from 3.05 million tons of ore milled averaging 0.748 ounce per ton. In tonnage extracted and milled the Vaal Reefs mine was larger, however, with 6.49 million tons yielding 2.08 million ounces from ores averaging 0.321 ounce per ton. The deepest mine remained the Western Deep Levels at more than 12,000 feet to bottom. Mines with over 1 million ounces production in 1974 were as follows: West Driefontein, Vaal Reefs, Western Deep Levels, President Brand, Western Holdings, Free State Geduld, and Hartebeestfontein. Significant amounts of uranium were also produced with gold at eight mines as follows: Vaal Reefs, Buffelsfontein, Harmony, Hartebeestfontein, West Driefontein, Blyvooruitzicht, Western Deep Levels, and West Rand Consolidated.

Exploration activities were high in the South African gold areas during the year. Two new mines were under development, one at Buffelsdoorn by Anglo American Corp. of South Africa Ltd., and the other at Deelkraal, east of Buffelsdoorn, by Gold Fields of South Africa Ltd. Each property was expected to require on the order of $150 million to start production. Promising exploration results were reported near the Jeanette mine in the Orange Free State and various locations on the Witwatersrand. Anglo American Corp. announced plans to spend $90 million on improved housing for 120,000 African miners on the company payroll. During the fiscal year ending May 31, 1974, tax payments to the Government by South African gold mines were $330 million, nearly double those of fiscal 1973 and lease payments nearly doubled to $156 million. Bids by several firms to acquire Union Corp. were unsuccessful.

Surinam.—Placer Development Ltd. (Canada) and the Surinam Government signed a joint venture agreement in June to explore and mine gold deposits near the town of Brokopondo. Most past production has been in the areas of Lawa and Tapanahony.

U.S.S.R.—In a study by Consolidated Gold Fields Ltd., Soviet gold production was estimated to have doubled in the past 12 years and was expected, according to Soviet plans, to approximate 14 million ounces in 1975. Byproduct gold comprised 11% of production. Main gold producing areas included the following: Severovostok, 24%; Yakut, 15%; Zabaikal, 7%; Zapsib, 6%; Armenia, 5%; Uzbek, 5%; Lena, 4%; Amur, 3%; Kazak, 2%; Ural 2%; and Yenisey, Altai, Primorsky, Tadzhik, Kirgiz, and others, 27%. Individual producers in unspecified areas accounted for 9% of the total 1975 production. Expected production from gold ores was 5.7 million ounces in 1975, with about 1.4 million ounces from three large strip operations (NizhnyKuranakh, Muruntau, and Bakyrchik), 3.1 million ounces from 17 principal underground mines (including Zod, Darasun, Taseev, Berezov, Kachkanar, Sovetskoye, and Matrasov), and the remainder from a number of smaller mines. Milling practices mentioned generally included flotation, cyanidation, activated carbon extraction, ion extraction, and a "sorption" process. Placer mining should account for nearly 50% of total gold output in 1975, mainly from the Siberian area of the country.

TECHNOLOGY

Studies were conducted in Bureau of Mines laboratories at Reno, Nev., and Salt Lake City, Utah, on two main approaches to gold recovery from low grade ores—electro-oxidation and heap leaching.

At Reno, studies were mainly directed at an electro-oxidation process in which a brine solution of the ore pulp is subjected to electrolysis causing a hypochlorite to form which oxidizes organic compounds that can interfere with cyanide gold extraction. A procedure was developed in which gold extraction from carbonaceous ores was improved from about 30% to the 87% to 95% range, with electric power consumption of 40 to 60 kilowatt-hours and salt consumption of 20 to 60 pounds per ton of ore. Late in the year, onsite studies were conducted at the Carlin gold mine in Nevada to determine if electro-oxidation might be more economical than the existing chlorine gas treatment on the carbonaceous portion of the Carlin ores. Comparative data showed that electrical power costs to achieve similar results would be only 22% to 33% of costs for chlorination. Other studies showed that the 10% brine solution required would not be deleterious to the succeeding cyanidation circuits. Laboratory studies were conducted on electrode wear in a 30% pulp slurry with 4.5% sodium chloride to determine typical replacement costs. Also at Reno, a test unit was constructed to strip and electrowin gold and silver values from activated carbon using ethanol and methanol in an alkaline solution. Recycling of carbon after ethanol stripping was improved by dewatering in a basket centrifuge followed by two-stage washing with 2% nitric acid solution. The process was submitted for patent.

At Salt Lake City, heap-leaching results were studied using samples from various Western gold properties, and methods were found to improve activated carbon gold extraction. An improved cell was developed for electrowinning gold from carbon strip solutions. Elevated-temperature, pressure-stripping experiments continued for accelerating removal of gold from the carbon. The various uses of activated carbon in gold extraction systems were reviewed and relative cost factors for three processes were compared.[7] Heap leaching was estimated to require 23% of the capital and 30% to 44% of the operating costs of a traditional cyanidation plant with a 2,500-ton-per-day capacity. A factor in the comparison was a somewhat lower gold recovery rate, in general, by heap leaching.

The use of a carbon-in-pulp gold cyanidation technique at the Homestake gold mine, South Dakota, was described.[8] The treatment was used on the slime fraction of the mill product and has been successful in lowering costs and improving gold recovery. Carbon was reactivated by heating to 1,100° F in a small gas-fired rotary kiln in the absence of air for a period of one-half hour.

A process was patented using chlorine gas to oxidize carbonaceous material in sedimentary gold ore before cyanidation at the Carlin mill in Nevada.[9] Several techniques of increasing recoveries of gold from refractory ores were patented involving treatment with a gaseous stream of chlorine at an elevated temperature in the presence of certain compounds acting as promoters.[10] A speedup in gold and silver cyanidation was realized by addition of stabilized solutions of peroxides in another process.[11] The resulting electrolyte solution was said to be suitable for direct electrodeposition. In one test, 99% of the gold from the treated ore was extracted in 50 minutes.

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[7] Potter, G. M., and H. P. Salisbury. Innovations in Gold Metallurgy. Min. Cong. J., v. 60, No. 7, July 1974, pp. 54–57.

[8] Hall, K. B. Homestake Uses Carbon-in-Pulp. World Min., v. 27, No. 12, November 1974, pp. 44–49.

[9] Guay, W. J. (assigned to Newmont Exploration Ltd.). Method of Pre-Treating Organic Carbon-Containing Sedimentary Gold Ore. U.S. Pat. 3,846,124, Nov. 5, 1974.

[10] Heinen, H. J., J. A. Eisele, and D. D. Fischer (assigned to Secretary of the Interior). Recovery of Gold From Ores. U.S. Pat. 3,825,651, July 23, 1974.

Eisele, J. A., and H. J. Heinen (assigned to Secretary of the Interior). Extraction of Gold From Refractory Ore. U.S. Pat. 3,834,896. Sept. 10, 1974.

[11] Woods, J. L., and Tobe A. Pittman (assigned to Elmet, Inc.). Process for Recovering Gold and Silver. U.S. Pat 3,826,723, July 30, 1974.

A solvent extraction method for gold was used on a production scale by a Canadian refiner, promising more efficient extraction from aqua regia solutions.[12] Dibutyl Carbitol was the extracting solvent. An increased yield of pure metal was claimed compared with extraction by ferrous sulfate and electolysis. Gold, silver, and copper values in a cyanide solution were concentrated by a semipermeable membrane of selected polymers in a new process utilizing reverse osmosis.[13]

In development of gold exploration technology, a report was published describing studies of sampling methods for placer gravels in the Sierra Nevada foothills of northern California.[14] Tests were made of a truck-mounted rotary drill, a vibratory drill, and a bucket drill to determine characteristics and reliability of each. For onsite control of the mining grade of ore at the Gold Acres gold property in Nevada, a mobile laboratory was used employing an atomic absorption spectrophotometer unit.[15] Samples were taken and analyzed close to the working face at the rate of about 50 per day.

Mining technology improvements in the Republic of South Africa were the object of a new research program initiated by the Chamber of Mines of South Africa.[16] A 10-year program was planned to increase gold mining productivity. A mining system new to the South African goldfields—sublevel stoping—was used in an area of the Lorraine gold mine where a number of reef bands merged to form a zone about 70 feet thick.[17] A new design for cement and timber packs used in stope support in a South African mine was said to result in savings of material and labor.[18] A high-thrust raise borer was used to drill 9-foot-diameter holes over 300 feet long in quartzite at the Vaal Reefs South gold mine in South Africa.[19]

Depositional controls for gold deposits in the Black Hills region of South Dakota were discussed and suggestions given as to where new discoveries might be made.[20] Three main controls were recognized: Cross folds; the Homestake formation; and proximity to the "garnet isograd", a zone of metamorphic change characterized by increased garnet content. Favorable target areas were said to include the area north of Lead, the Portland and Ruby Basin region, and the Rockerville area. A study of lead isotopes in ores of the Homestake gold mine, South Dakota, showed that the deposit was Precambrian age and that Tertiary veinlets in the Precambrian host rocks and Tertiary intrusive rocks were derived from Precambrian rocks.[21]

Results of a geochemical study for gold in Precambrian and Paleozoic sedimentary rocks in the Great Lakes region suggested that if fossil gold placers were present they might be in the basal Paleozoic clastic rocks near James Bay, Canada, north of the Great Lakes.[22] Several reports were published on past gold placer mining; one covered deposits in Colorado[23] and another described activities in the Southwestern United States.[24]

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[12] Rimmer, B. F. Refining of Gold From Precious Metal Concentrates by Liquid-Liquid Extraction. Chem. & Ind., No. 2, Jan. 19, 1974, pp. 63–66.

[13] Gosser, L. W. (assigned to E. I. du Pont de Nemours & Co.). Selective Concentration of Gold, Silver, and Copper in Aqueous Cyanide Solutions. U.S. Pat. 3,816,587, June 11, 1974.

[14] McLellan, R. R., R. D. Berkenkotter, R.C. Wilmot, and R. L. Stahl. Drilling and Sampling Tertiary Gold-Bearing Gravels at Badger Hill, Nevada County, Calif. BuMines RI 7935, 1974, 50 pp.

[15] Mining Journal (London). Assaying: Mobile Laboratory in Open Pit. V. 281, No. 7218, Dec. 21, 1973, p. 510.

[16] Rapson, W.S. Productivity in Gold Mining Technology: A Research Program to Offset Increased Costs. Gold Bull. (Chamber of Mines of South Africa, Research Organization, Johannesburg), v. 7, No. 4, October 1974, pp. 106–107.

[17] Mining Magazine (London). Sub-Level Stoping at Loraine Gold Mines in South Africa. V. 131, No. 5, November 1974, pp. 359–365.

[18] Mining Magazine. Stope Support at Elsburg Gold Mine. V. 130, No. 2, February 1974, pp. 105–106.

[19] Northern Miner (Toronto). High-Thrust Raise Borer Successful in South African Hard Rock Test. V. 60, No. 36, Nov. 21, 1974, p. 17.

[20] Norton, J. J. Gold in the Black Hills, South Dakota, and How New Deposits Might Be Found. U. S. Geol. Survey, Circ. 699, 1974, 22 pp.

[21] Rye, D. M., B. R. Doe, and M. H. Delevaux. Homestake Gold Mine: II. Lead Isotopes, Mineralization Ages, and Source of Lead in Ores of the Northern Black Hills. Econ. Geol., v. 69, 1974, pp. 814–822.

[22] Seeland, D. A. A Geochemical Reconnaissance for Gold in the Sedimentary Rocks of the Great Lakes Region, Minnesota to New York. U.S. Geol. Survey, Bull. 1305, 1973, 16 pp.

[23] Parker, B. H., Jr. Gold Placers of Colorado. Colo. School Mines Quarterly, v. 69, No. 3, July 1974, 266 pp.; v. 69, No. 4, October 1974, 224 pp.

[24] Johnson, M. G. Placer Deposits in the Southwest. Min. Eng., v. 26, No. 3, March 1974, pp. 20–23.

Table 3.—Mine production of recoverable gold in the United States, by State

(Troy ounces)

State	1970	1971	1972	1973	1974
Alaska	34,776	13,012	8,639	7,107	9,146
Arizona	109,853	94,038	102,996	102,848	90,586
California	4,999	2,966	3,974	3,647	5,049
Colorado	37,114	42,031	61,100	63,422	52,083
Idaho	3,128	3,596	2,884	2,696	2,893
Montana	22,456	15,613	23,725	27,806	28,268
Nevada	480,144	374,878	419,748	260,437	298,754
New Mexico	8,719	10,681	14,897	13,864	15,427
Oregon	256	244	W	W	W
South Dakota	578,716	513,427	407,430	357,575	343,728
Tennessee	124	192	176	68	18
Utah	408,029	368,996	362,413	307,080	254,909
Other States[1]	55,008	55,434	41,961	29,200	26,025
Total	1,743,322	1,495,108	1,449,943	1,175,750	1,126,886

W Withheld to avoid disclosing individual company confidential data included in "Other States."

[1] Includes North Carolina (1971), Oregon (1972–74), Pennsylvania (1970–71), and Washington.

Table 4.—Mine production of recoverable gold in the United States, by month

(Troy ounces)

Month	1973	1974
January	102,252	87,860
February	104,482	87,624
March	102,045	101,643
April	99,336	104,632
May	101,693	106,301
June	102,665	100,052
July	93,537	82,039
August	97,374	85,601
September	87,114	89,435
October	102,554	97,674
November	91,403	93,098
December	91,295	90,927
Total	1,175,750	1,126,886

Table 5.—Twenty-five leading gold-producing mines in the United States in 1974, in order of output

Rank	Mine	County and State	Operator	Source of gold
1	Homestake	Lawrence, S. Dak	Homestake Mining Co	Gold ore.
2	Utah Copper	Salt Lake, Utah	Kennecott Copper Corp	Copper, gold ores.
3	Carlin	Eureka, Nev	Carlin Gold Mining Co	Gold ore.
4	Cortez	Lander, Nev	Cortez Gold Mines	Do.
5	Sunnyside	San Juan, Colo	Standard Metals Corp	Lead-zinc ore.
6	Knob Hill	Ferry, Wash	Knob Hill Mines, Inc	Gold ore.
7	San Manuel	Pinal, Ariz	Magma Copper Co	Copper ore.
8	Berkeley Pit	Silver Bow, Mont	The Anaconda Company	Copper, silver ores.
9	Ruth Pit	White Pine, Nev	Kennecott Copper Corp	Copper, gold ores.
10	New Cornelia	Pima, Ariz	Phelps Dodge Corp	Do.
11	Copper Queen-Lavender Pit	Cochise, Ariz	do	Copper ore.
12	Magma	Pinal, Ariz	Magma Copper Co	Do.
13	Idarado	Ouray and San Miguel, Colo	Idarado Mining Co	Copper-lead-zinc ores.
14	Copper Canyon	Lander, Nev	Duval Corp	Copper ore.
15	Morenci	Greenlee, Ariz	Phelps Dodge Corp	Do.
16	Bootstrap	Elko, Nev	Carlin Gold Mining Co	Gold ore.
17	Continental	Grant, N. Mex	UV Industries, Inc	Copper ore.
18	Leadville Unit	Lake, Colo	American Smelting & Refining Co	Lead-zinc ore, lead-zinc cleanup.
19	Hogatza River	Yukon River Region, Alaska	UV Industries, Inc	Placer.
20	Trixie	Utah, Utah	Kennecott Copper Corp	Gold-silver ore.
21	Tyrone	Grant, N. Mex	Phelps Dodge Corp	Copper ore.
22	Butte Hill Copper Mines	Silver Bow, Mont	The Anaconda Company	Do.
23	Christmas	Gila, Ariz	Inspiration Consolidated Copper Co	Do.
24	Chino	Grant, N. Mex	Kennecott Copper Corp	Do.
25	Sacaton Unit	Pinal, Ariz	American Smelting & Refining Co	Do.

Table 6.—Production of gold in the United States in 1974, by State, type of mine, and class of ore yielding gold, in terms of recoverable metal

State	Placer (troy ounces of gold)	Lode					
		Gold ore		Gold-silver ore		Silver ore	
		Short tons	Troy ounces of gold	Short tons	Troy ounces of gold	Short tons	Troy ounces of gold
Alaska	9,146	--	--	--	--	--	--
Arizona	--	17,458	43	--	--	709	7
California	2,809	2,006	1,628	2,468	539	--	--
Colorado	226	W	W	W	W	W	W
Idaho	24	652	180	1,645	135	430,129	748
Montana	148	4,467	1,006	21,388	2,420	28,961	121
Nevada	--	2,830,587	266,383	12,704	652	154	6
New Mexico	--	--	--	4,401	559	--	--
South Dakota	--	1,559,691	343,723	--	--	--	--
Tennessee	--	--	--	--	--	--	--
Other States[1]	22	183,252	28,056	22,071	3,453	100,052	215
Total	12,370	4,598,058	641,014	64,677	7,758	560,005	1,097
Percent of total gold	1	--	57	--	1	--	(2)

State	Lode					
	Copper ore		Lead ore		Zinc ore	
	Short tons	Troy ounces of gold	Short tons	Troy ounces of gold	Short tons	Troy ounces of gold
Alaska	--	--	--	--	--	--
Arizona	132,563,233	89,765	412	1	667	25
California	11	7	--	--	--	--
Colorado	W	W	3,001	43	195,563	400
Idaho	W	W	182,051	1,104	W	W
Montana	18,625,016	24,308	205	23	760	44
Nevada	13,467,158	31,643	2,270	22	50	6
New Mexico	26,343,258	14,469	--	--	W	W
South Dakota	--	--	--	--	--	--
Tennessee	--	--	--	--	--	--
Other States[1]	35,458,852	250,656	--	--	183,657	262
Total	226,457,528	410,848	187,939	1,193	380,697	737
Percent of total gold	--	36	--	(2)	--	(2)

State	Lode					
	Copper-lead, lead-zinc, copper-zinc, and copper-lead-zinc ores		Old tailings, etc.		Total[3]	
	Short tons	Troy ounces of gold	Short tons	Troy ounces of gold	Short tons	Troy ounces of gold
Alaska	--	--	--	--	--	9,146
Arizona	92,820	441	67,249	304	132,742,543	90,586
California	800	5	6	[4] 66	5,291	5,049
Colorado	860,900	49,648	32,180	195	1,215,423	52,083
Idaho	995,558	616	2	3	1,626,688	2,898
Montana	196	14	9,020	189	18,690,013	28,268
Nevada	301,688	42	--	--	16,614,561	298,754
New Mexico	W	W	--	--	26,525,983	15,427
South Dakota	--	--	--	--	1,559,691	343,723
Tennessee	1,153,035	18	--	--	1,153,035	18
Other States[1]	172,689	325	29	3	35,801,848	280,934
Total	3,577,686	51,109	108,486	760	235,935,076	1,126,886
Percent of total gold	--	5	--	(2)	--	100

W Withheld to avoid disclosing individual company confidential data included in "Other States."

[1] Includes Oregon, Utah, and Washington and items indicated by symbol W.

[2] Less than ½ unit.

[3] Data may not add to State totals due to items withheld to avoid disclosing individual company confidential data.

[4] Includes byproduct gold recovered from tungsten ore.

Table 7.—Gold produced in the United States from ore, old tailings, etc., in 1974, by State and method of recovery, in terms of recoverable metal

State	Total ore, old tailings, etc., treated [1] (thousand short tons)	Ore and old tailings to mills					Crude ore, old tailings, etc., to smelters [1]	
		Thousand short tons [1]	Recoverable in bullion		Concentrates smelted and recoverable metal			
			Amalgamation (troy ounces)	Cyanidation (troy ounces)	Concentrates (short tons)	Troy ounces	Thousand short tons	Troy ounces
Arizona	179,096	178,685	--	--	3,119,674	88,323	411	2,263
California	[2] 5	[2] 3	--	--	639	569	2	1,671
Colorado	[3] 1,321	[3] 1,312	11,074	929	152,124	39,360	9	494
Idaho	1,767	1,764	17	--	160,178	2,534	3	323
Montana	23,232	23,141	--	--	441,231	24,405	91	3,720
Nevada	[3] [4] 23,110	[3] [4] 23,054	650	265,811	371,356	31,848	56	445
New Mexico	26,558	26,463	--	--	374,924	14,868	95	559
South Dakota	1,560	1,560	--	343,723	--	--	--	--
Utah	35,824	35,627	--	--	789,983	250,416	197	4,493
Other States [5]	[4] 4,546	[4] 4,539	8	7,674	208,929	17,286	7	1,053
Total	297,019	296,148	11,749	618,137	6,119,038	469,609	871	15,021

[1] Includes some nongold-bearing ores not separable.
[2] Excludes tonnage of tungsten ore from which gold was recovered as a byproduct.
[3] Includes tonnages from which gold is heap leached.
[4] Includes tonnages from which gold is vat leached.
[5] Includes Oregon, Tennessee, and Washington.

Table 8.—Gold produced at amalgamation and cyanidation mills in the United States and percentage of gold recoverable from all sources

Year	Bullion and precipitates recoverable (troy ounces)		Gold recoverable from all sources (percent)			
	Amalgamation	Cyanidation	Amalgamation	Cyanidation	Smelting [1]	Placers
1970	353,957	638,966	20.3	36.7	40.8	2.2
1971	3,071	832,468	.2	55.7	43.0	1.1
1972	3,999	792,364	.3	54.6	44.2	.9
1973	15,381	583,311	1.3	49.6	48.1	1.0
1974	11,749	618,137	1.0	54.9	43.0	1.1

[1] Crude ores and concentrates.

Table 9.—Gold production at placer mines in the United States, by method of recovery

Method and year	Mines producing	Washing plants	Material washed (thousand cubic yards)	Gold recoverable		
				Thousand troy ounces	Value (thousands)	Average value per cubic yard
Bucketline dredging:						
1972	2	2	[1] 558	4	$246	$0.441
1973	2	2	[1] 649	4	402	.619
1974	2	2	[1] 656	5	877	1.336
Dragline dredging:						
1972	1	1	([2]) --	[3] 1	27	([4])
1973	3	3	[2] 55	[3] 1	115	[4] 2.091
1974	1	1	13	1	131	9.984
Hydraulicking:						
1972	16	16	230	3	187	.813
1973	12	12	245	2	167	.682
1974	16	16	228	2	381	1.710
Nonfloating washing plants:						
1972	35	35	[2] 123	[3] 5	291	[4] 2.366
1973	34	34	[2] 32	[3] 5	454	[4] 14.188
1974	14	14	[2] 2	[3] 3	461	[4] 229.130
Underground placer, small-scale mechanical and hand methods, and suction dredge:						
1972	14	4	2	([5])	6	3.000
1973	20	3	19	([5])	43	2.263
1974	10	5	105	1	126	1.203
Total placers:						
1972	68	58	[1] [2] 913	[3] 13	757	[4] .829
1973	71	54	[1] [2] 1,000	[3] 12	1,181	[4] 1.181
1974	43	38	[1] [2] 999	[3] 12	1,976	[4] 1.977

[1] Does not include platinum-bearing material from which byproduct gold was recovered.

[2] Excludes tonnage of material treated at commercial sand and gravel operations recovering byproduct gold.

[3] Includes gold recovered at commercial sand and gravel operations recovering byproduct gold.

[4] Gold recovered as a byproduct at sand and gravel operations not used in calculating average value per cubic yard.

[5] Less than ½ unit.

Table 10.—U.S. gold consumption in industry and the arts [a]

(Thousand troy ounces)

Industry group	1970	1971	1972	1973	1974
Jewelry and arts	3,340	4,299	4,344	3,473	2,402
Dental	658	750	750	679	509
Industrial, including space and defense	1,975	1,884	2,191	2,577	1,740
Total	5,973	6,933	7,285	6,729	4,651

[a] Estimated by Office of Domestic Gold and Silver Operations, U.S. Treasury Department.

Table 11.—U.S. exports of gold in 1974, by country

Destination	Ore, base bullion and scrap		Refined bullion	
	Troy ounces	Value (thousands)	Troy ounces	Value (thousands)
Australia	--	--	1,700	$223
Belgium-Luxembourg	140,581	$22,505	--	--
Brazil	--	--	810	128
Canada	10,867	1,795	389,281	42,970
Germany, West	28,139	4,590	--	--
Hong Kong	10	1	--	--
Israel	8	1	--	--
Italy	225	34	460	75
Japan	26,309	3,960	--	--
Mexico	--	--	203,874	8,828
Netherlands	1,339	250	--	--
Panama	--	--	10	2
Saudi Arabia	--	--	2,582,870	109,055
Singapore	400	58	--	--
Sweden	2,672	467	--	--
Switzerland	317	38	358,635	15,230
United Kingdom	97,214	15,711	12,479	1,855
Venezuela	--	--	5,074	709
Total	308,081	49,410	3,555,193	179,070

Table 12.—U.S. imports (general) of gold in 1974, by country

Country	Ore and base bullion		Refined bullion	
	Troy ounces	Value (thousands)	Troy ounces	Value (thousands)
Australia	41,835	$5,672	1,783	$285
Belgium-Luxembourg	--	--	11,510	1,906
Canada	49,273	7,081	904,673	136,047
Chile	9,322	1,185	--	--
China, Republic of	940	128	--	--
Dominican Republic	2,134	145	--	--
El Salvador	87	12	--	--
France	3,128	555	156,259	25,417
Germany, West	354	55	3,598	597
Guatemala	263	18	--	--
Guyana	405	38	--	--
Honduras	1,585	218	--	--
Hong Kong	50	2	--	--
Israel	12	2	--	--
Italy	392	29	--	--
Japan	1,246	121	5,747	916
Kenya	278	42	--	--
Korea, Republic of	1,333	112	--	--
Lebanon	--	--	3,198	342
Malaysia	108	4	--	--
Mexico	6,938	721	--	--
Netherlands	35	1	5,064	918
Nicaragua	17,277	2,277	--	--
Norway	383	49	--	--
Panama	1,916	121	--	--
Peru	30,516	4,206	--	--
Philippines	67,888	10,753	--	--
Portugal	254	24	--	--
Singapore	69,638	10,197	--	--
South Africa, Republic of	8,535	1,296	--	--
Switzerland	340	31	442,972	68,329
U.S.S.R	41	4	575,447	82,924
United Kingdom	4,490	664	119,635	18,956
Venezuela	8,361	211	--	--
Yugoslavia	--	--	92,100	14,069
Total	329,357	45,974	2,321,981	350,706

Table 13.—Value of gold imported into and exported from the United States
(Thousand dollars)

Year	Exports	Imports
1972	63,053	357,689
1973	145,965	356,150
1974	228,480	396,680

Table 14.—Gold: World production[1] by country

(Troy ounces)

Country[2]	1972	1973	1974[p]
North America:			
Canada	[r] 2,078,567	1,954,340	1,718,000
Costa Rica	10,000	15,500	18,000
El Salvador	2,861	5,233	6,022
Haiti	(3)	(3)	--
Honduras	2,021	795	2,124
Mexico	146,061	132,557	134,454
Nicaragua	112,340	85,051	82,639
United States	1,449,943	1,175,750	1,126,886
South America:			
Bolivia	[r] 20,059	35,964	[4] 41,600
Brazil	203,771	203,096	[e] 210,000
Chile	[r] 94,571	97,995	118,829
Colombia	[r] 188,137	215,876	265,195
Ecuador	12,623	10,420	7,752
French Guiana	997	1,350	[e] 1,400
Guyana	4,026	7,551	[e] 8,000
Peru	[r] 79,274	104,490	[e] 110,000
Surinam	547	96	[e] 100
Venezuela	[r] 20,292	19,105	17,028
Europe:			
Finland	17,619	19,773	20,737
France	[r] 58,386	55,235	42,085
Germany, West	2,710	2,087	1,313
Portugal	16,718	14,645	13,754
Romania[e]	60,000	60,000	60,000
Sweden	57,550	80,923	[e] 85,000
U.S.S.R.[e]	6,900,000	7,100,000	7,300,000
Yugoslavia	136,898	176,347	[e] 177,000
Africa:			
Angola	1,704	[r] [e] 2,000	[e] 2,000
Cameroon	50	83	64
Central African Republic[e]	64	64	64
Congo (Brazzaville)	[r] 2,082	1,254	[e] 1,000
Ethiopia	20,784	19,575	15,754
Gabon	[r] 11,414	11,224	7,305
Ghana	724,051	722,531	[e] 760,000
Guinea[e]	4,000	4,000	4,000
Kenya	34	150	[e] 150
Liberia[5]	1,324	--	--
Mali	[e] 30	[e] 30	--
Malagasy Republic	190	71	77
Mozambique	5	--	--
Nigeria	12	21	113
Rhodesia, Southern[e]	502,000	500,000	500,000
South Africa, Republic of	29,245,273	27,494,603	24,362,868
Sudan	95	49	309
Tanzania	213	56	42
Zaire	[r] 140,724	133,650	126,449
Zambia	8,858	1,608	5,755
Asia:			
China, People's Republic of[e]	50,000	50,000	50,000
India	105,776	105,390	101,114
Indonesia	[r] 35,274	42,785	64,678
Japan[6]	243,027	187,631	139,727
Khmer Republic[e]	4,000	4,000	4,000
Korea, North[e]	160,000	160,000	160,000
Korea, Republic of	17,072	16,268	23,406
Malaysia:			
Malaya	[r] 3,780	2,730	3,495
Sarawak	1,663	939	[e] 1,000
Philippines	606,730	572,319	536,399
Taiwan	17,882	22,197	22,850
Oceania:			
Australia	[r] 754,866	554,278	520,102
British Soloman Islands Protectorate	200	520	--
Fiji	[r] 81,590	79,983	68,890
New Zealand	13,511	11,044	4,710
Papua-New Guinea	409,125	[7] 722,341	[7] 726,047
Total	[r] 44,843,374	42,997,573	39,780,281

[e] Estimate. [p] Preliminary. [r] Revised.

[1] Unless otherwise indicated, production is on the basis of mine output.

[2] Gold is also produced in Bulgaria, Czechoslovakia, Spain, and probably in small quantities in Argentina, Burma, East Germany, Hungary, Thailand, and several other countries. However, available data are insufficient to make reliable output estimates. Data are lacking on clandestine activities.

[3] Revised to zero.

[4] Partial figure representing sales by medium mines to the Central Bank, excludes a relatively small quantity mined as byproduct of COMIBOL operations.

[5] Purchased by the Bank of Monrovia.

[6] Refinery production for Japan was as follows: 1972—[r] 846,239 ounces; 1973—1,052,775 ounces; 1974—1,123,474 ounces.

[7] Recoverable gold from copper ore; total content of copper ore was as follows in troy ounces: 1973—1,057,782; 1974—1,094,082.

Graphite

By W. Timothy Adams [1]

Crystalline natural-graphite flake remained in short supply throughout 1974 and the market continued tight throughout the year. Prices of this imported flake rose approximately 20% compared with 1973 prices. The principal cause of the shortage was the continued lack of production in the Malagasy Republic, the main source of large-flake crystalline graphite. However, supplies of Mexican amorphous graphite remained sufficient, and attempts to substitute it for the scarce crystalline flake appear to have been moderately successful.

Imports of natural crystalline and amorphous graphite were up 5%, crystalline flake gained approximately 1,000 tons. Exports of natural graphite increased 53% to 12,189 tons.

The difficult supply problem was maintained as demand continued strong for the fourth consecutive year.

The manufactured-graphite industry had another good year as production increased 8%. Production of electrodes decreased slightly, whereas production of crucibles and vessels increased sharply. Major expansions of facilities were announced by several producers.

Table 1.—Salient natural graphite statistics

	1970	1971	1972	1973	1974
United States:					
Consumption [e] [1] .... short tons ..	50,000	60,000	70,000	79,000	94,867
Exports .... do	5,783	5,733	7,289	7,953	12,189
Value .... thousands ..	$701	$680	$888	$992	$1,693
Imports for consumption [2] short tons ..	66,449	57,756	64,135	[r] 77,431	82,636
Value .... thousands ..	$3,027	$2,727	$3,847	[r] $4,494	$5,677
World: Production .... short tons ..	483,047	433,925	[r] 397,894	[r] 409,428	431,531

[e] Estimate. [r] Revised.

[1] Estimated demand has been substituted for the consumption survey results previously published, since the latter are incomplete. A figure comparable to the previous series appears as the total of table 4.

[2] Includes some manufactured graphite.

Legislation and Government Programs.—As part of the effort to reduce strategic stockpile inventories, more than 50% of the natural graphite in the stockpile was declared surplus by the General Services Administration (GSA). Although GSA determines the requirements for strategic materials, congressional authorization is still required for disposal. Of the three types of stockpiled graphite, about 50% of the Malagasy and Sri Lanka types and all of the other types were placed on the surplus list. However, congressional authorization for their disposal has not been obtained, and no sales were made. All stockpiled graphite that was previously authorized for disposal was sold and shipped.

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[1] Physical scientist, Division of Nonmetallic Minerals.

Table 2.—Government yearend stocks of natural graphite
(Short tons)

Type of graphite	National stockpile
Malagasy crystalline flake:	
Objective	4,900
Uncommitted excess	5,900
Total	10,800
Malagasy crystalline fines:	
Objective	3,300
Uncommitted excess	[1] 3,839
Total	[1] 7,139
Sri Lanka amorphous lump:	
Objective	3,100
Uncommitted excess	[2] 2,399
Total	[2] 5,499
Other than Malagasy and Sri Lanka, crystalline: Uncommitted excess	[3] 2,802

[1] Includes 1 short ton nonstockpile-grade material.
[2] Includes 56 short tons nonstockpile-grade material.
[3] Includes 867 short tons nonstockpile-grade material.
Source: General Services Administration. Stockpile Report to the Congress, July–December 1974.

DOMESTIC PRODUCTION

In 1974, natural-graphite production in the United States was again from a single location, the Southwestern Graphite Co. mine near Burnet, Tex. Shipments from the mine were slightly higher than in 1973, and continued to account for only a small portion of the domestic supply. Other graphite deposits in Alabama, California, Idaho, New York, Texas, and Virginia continued to arouse the interest of investigators contemplating the development or redevelopment of additional mines, but no mine openings occurred by yearend.

Production of manufactured graphite continued to increase in 1974. Output of 322,513 tons was up 5% from the 306,212 tons produced in 1973. Total value of production increased 27% to $280.1 million from $220.0 million in 1973. The use of powder and scrap material increased from 25,722 tons valued at $3.7 million in 1973 to 35,390 tons valued at $13.5 million in 1974.

Metallurgical use of manufactured graphite showed a small advance. Although electrode production decreased, the tonnage used in crucibles and vessels increased sharply as the metallurgical industry continued its changeover to processes such as continuous casting, which make use of increased amounts of graphite. Unmachined shapes also continued to advance. Graphite-fiber composites have gained consumer acceptance in the leisure-products and sporting-goods industries. As a result, production costs of graphite fibers have dropped substantially and are expected to continue to decrease. The development of hybrid composites, such as graphite-polyimide and Kevlar-graphite-epoxy, provided a combination of properties that overcome many of the deficiencies of earlier composites such as graphite-epoxy and graphite-polyester. With the hybrid materials available in broad-woven form and with better fabrication techniques, assemblies became less labor intensive. The aerospace industry was quick to take advantage of these new developments and used composite assemblies in the B–1 bomber and F–16 and YF–17 fighters. The Teledyne Ryan Aeronautical YQM–98A remotely piloted aircraft used more than 100 hybrid composite assemblies including primary-structure, outer-wing panels. The Wendecker Eagle private aircraft was built using all-composite construction. Potential industrial applications generated interest, since the composites are lightweight and have acoustical and vibration dampening, and heat stability characteristics.

Manufactured graphite was produced at 25 plants in 1974, and some additional production for inhouse use was likely. The following is a list of principal producers in 1974.

Company	Plant location
Airco, Inc., Speer Div	Niagara Falls, N.Y.
Do	Punxsutawney, Pa.
Do	St. Marys, Pa.
Avco Corp., Avco Systems Div.	Lowell, Mass.
The Carborundum Co., Graphite Products Div.	Hickman, Ky.
Do	Sanborn, N.Y.
Celanese Corp., Celanese Research Lab.	Summit, N.J.
Fiber Materials, Inc	Graniteville, Mass.
Great Lakes Carbon Corp.	Rosamond, Calif.
Do	Niagara Falls, N.Y.
Do	Morganton, N.C.
Hercules, Inc	Bacchus, Utah.
HITCO	Gardena, Calif.
Morganite Modmor, Inc.	Costa Mesa, Calif.
Ohio Carbon Co	Cleveland, Ohio.
Pfizer, Inc., Minerals Pigments and Metals Div.	Easton, Pa.
Poco Graphite, Inc	Decatur, Tex.
Polycarbon, Inc	North Hollywood, Calif.
Stackpole Carbon Co	Lowell, Mass.
Do	St. Marys, Pa.
Super Temp Co	Santa Fe Springs, Calif.
Union Carbide Corp	Niagara Falls, N.Y.
Do	Yabucoa, P.R.
Do	Columbia, Tenn.
Wickes Engineered Materials.	Saginaw, Mich.

An expansion of the graphite fiber production facility at Bacchus, Utah, was announced by Hercules, Inc. New equipment will enable doubling the plant output.[2]

Table 3.—Production of manufactured graphite in the United States in 1974, by use

Use	Quantity (short tons)	Value (thousands)
Manufactured graphite products:		
Electrodes	209,466	$176,060
Crucibles and vessels	19,655	22,519
Motor brushes and machine shapes	2,592	7,250
Unmachined shapes	19,755	W
Cloth and fibers	65	W
Other	[1] 70,980	[2] 74,820
Total	322,513	280,149
Synthetic graphite powder and scrap	35,390	13,524
Grand total	357,903	293,673

W Withheld to avoid disclosing individual company confidential data; included with "Other."

[1] Includes anodes, refractories, high-modulus fibers, and other minor products.

[2] Includes anodes, unmachined shapes, cloth, fiber, high-modulus fibers, and other minor products.

Union Carbide Corp. selected Clarkesville, Tenn., as the site of its major new graphite-electrode plant. The initial unit is scheduled to go into operation in 1977.[3] Union Carbide had previously announced a 20% expansion of capacity at its Columbia, Tenn., and Yabucoa, P.R., plants. Initial production from the expanded facilities was scheduled for early 1975.[4]

Great Lakes Carbon Corp. announced a 50% increase in graphite-electrode-manufacturing capacity at plants in Niagara Falls, N.Y., Morganton, N.C., and Rosamond, Calif.[5] Airco Speer Carbon Graphite Div. of Airco Inc. announced a 25% increase in overall production capacity at the Niagara Falls, N.Y., and St. Marys, Pa., plants.[6]

CONSUMPTION AND USES

Demand for natural graphite remained strong in 1974. Consumption in steel mills increased sharply, but use in foundries dropped as activity in this area reflected the downturn in business. Use of graphite in brake and clutch linings and powdered metals also declined. Consumption in the manufacture of crucibles and associated products increased, reflecting efforts by that industry to decrease its dependence on Malagasy flake. Exports increased to 12,000 tons. Total consumption of natural graphite was considerably greater than that shown in table 4, which reports only the results from known graphite consumers. Total graphite consumption is estimated to have been approximately 95,000 tons in 1974.

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[2] Chemical Engineering. CPI News Briefs. V. 80, No. 29, Dec. 24, 1973, p. 78.

[3] American Metal Market. V. 82, No. 85, May 1, 1975, p. 4.

[4] Journal of Metals. V. 26, No. 3, March 1974, p. 11.

[5] Iron and Steel Engineer. V. 52, No. 3, March 1975, p. 81.

[6] Airco Inc. 1974 Annual Report.

Table 4.—Consumption[1] of natural graphite in the United States in 1974, by use

Use	Crystalline		Amorphous[2]		Total	
	Quantity (short tons)	Value	Quantity (short tons)	Value	Quantity (short tons)	Value
Batteries	16	$38,605	532	$475,146	548	$513,751
Brake linings	685	365,723	1,406	711,320	2,091	1,077,043
Carbon products[3]	670	W	1,264	W	1,934	819,652
Crucibles, retorts, stoppers, sleeves, nozzles	4,505	1,185,329	558	189,187	5,063	1,374,516
Foundries	1,813	W	9,168	W	10,981	3,744,145
Lubricants[4]	891	603,362	2,603	896,573	3,494	1,499,935
Pencils	1,974	1,075,213	417	99,366	2,391	1,174,579
Powdered metals	222	W	684	W	906	687,829
Refractories	1,219	146,143	7,516	924,606	8,735	1,070,749
Rubber	195	119,315	123	29,141	318	148,456
Steelmaking	660	122,068	22,950	4,969,536	23,610	5,091,604
Other[5]	4,649	2,378,530	319	4,099,223	4,968	1,226,127
Total	17,499	6,034,288	47,540	12,394,098	65,039	18,428,386

W Withheld to avoid disclosing individual company confidential data, included with "Other."

[1] Consumption data incomplete; excludes small consuming firms.

[2] Includes mixtures of natural and manufactured graphite.

[3] Includes bearings and carbon brushes; previously titled "Other mechanical products."

[4] Includes ammunition, packings, and seed coating.

[5] Includes paints and polishes, antiknock and other compounds, drilling mud, electrical and electronic products, insulation, magnetic tape, small packages, and miscellaneous and proprietary uses.

PRICES

Graphite prices rose sharply again in 1974 as the world shortage continued. Domestic prices responded to the higher cost of foreign graphite since most of the U.S. supply is imported. Prices of all the principal types of imported crystalline-flake graphite were significantly above their 1973 levels; increases ranged from 11% to 40%. Malagasy crystalline flake, the most important type of flake graphite, rose an average of 17% in price during the year. Sri Lanka amorphous lump and chip increased an average of 39%. Mexican graphite, the principal amorphous type imported, increased 30% in price.

Price quotations represent a range of prices. Actual prices are often on a negotiated basis between the buyer and the seller. One source of information for imported graphite is the average value per ton of the different classes of imports, which can be computed from table 6; however, it should be kept in mind that these represent mainly shipments of unprocessed graphite.

No published source of domestic price quotations has been found that reflects the increases that have taken place in the past several years. Price information can be obtained from the companies that produce and import natural graphite. The following tabulation shows representative prices of several types of imported graphite as of December 1974 published in the Engineering and Mining Journal. All prices are f.o.b. the foreign port or border station and have been converted from metric tons.

	Per short ton	
	1972	1973
Flake and crystalline graphite, bags:		
Germany, West	$204–$1,179	$234–$1,495
Malagasy Republic	159–476	188–558
Norway	109–181	150–247
Sri Lanka	181–318	248–446
Amorphous, nonflake cryptocrystalline graphite (80% to 85% carbon):		
Korea, Republic of (bags)	27	30
Mexico (bulk)	22	28.50

FOREIGN TRADE

A rise in exports of natural graphite occurred in 1974, continuing the upward trend begun in 1972. Exports gained 53% to 12,189 tons compared with 7,953 tons in 1973. The principal buyer was Canada, which took 4,277 tons. Other countries purchasing several hundred tons apiece were; Australia, Brazil, Italy, Japan, Mexico and the United Kingdom. Graphite was also exported to 29 additional countries.

Imports of natural graphite increased 3.9%, but the rise did not signal an end to the graphite-supply problem. Imports of amorphous graphite from Mexico were virtually the same as for 1973. Imports of crystalline flake from the Malagasy Republic increased 646 tons to 3,378 tons in 1974, which was 2,500 tons short of the 1972 figure. The figures appear to indicate a continued effort by industry to substitute the more plentiful amorphous graphite in products normally requiring crystalline flake, with a consequent increase in the quantities needed. The continued search by industry for crystalline flake resulted in imports of 548 tons from the U.S.S.R. and 187 tons from Malaysia, both new sources for this material. However, these amounts are insignificant compared with the shortfall in Malagasy flake.

Table 5.—U.S. exports of natural graphite,[1] by country

Destination	1973		1974	
	Quantity (short tons)	Value	Quantity (short tons)	Value
Argentina	17	$2,827	286	$39,130
Australia	280	30,585	934	103,046
Austria	--	--	98	7,688
Belgium-Luxembourg	48	6,522	109	11,335
Bolivia	--	--	82	11,552
Brazil	140	17,679	609	127,608
Canada	3,793	454,391	4,277	663,725
Chile	10	1,481	32	6,340
Colombia	67	9,691	55	9,498
Denmark	--	--	34	3,025
France	253	32,245	128	22,101
Germany, West	104	14,170	319	37,544
India	206	26,210	81	7,307
Indonesia	--	--	106	7,585
Iran	64	8,197	7	4,275
Italy	29	4,855	642	53,506
Jamaica	21	2,720	--	--
Japan	449	59,044	774	116,205
Korea, Republic of	--	--	77	15,845
Malaysia	81	10,301	53	6,873
Mexico	633	79,788	738	100,471
Netherlands	59	6,500	231	23,250
New Zealand	--	--	19	1,802
Norway	--	--	98	8,525
Panama	21	3,535	--	--
Peru	55	8,074	145	21,853
Philippines	124	14,552	245	26,386
Singapore	216	28,060	231	24,627
South Africa, Republic of	21	2,685	108	12,693
Sweden	61	8,659	144	16,751
Switzerland	11	1,422	51	3,915
Taiwan	--	--	35	4,513
United Kingdom	924	118,174	882	91,962
Venezuela	193	32,104	424	84,001
Other	73	8,333	135	17,837
Total	7,953	992,304	12,189	1,692,774

[1] Amorphous, crystalline (flake, lump, or chip), and natural n.e.c.

Table 6.—U.S. imports for consumption of natural and artificial graphite, by country

Year and country	Natural						Artificial[1]		Total	
	Crystalline flake		Crystalline lump, chip, or dust		Other natural crude and refined					
	Quantity (short tons)	Value (thousands)	Quantity (short tons)	Value (thousands)	Quantity (short tons)	Value (thousands)	Quantity (short tons)	Value (thousands)	Quantity (short tons)	Value (thousands)
1972	7,043	$1,135	121	$13	56,599	$2,643	372	$56	64,135	$3,847
1973:										
Australia	--	--	--	--	11	2	--	--	11	2
Austria	--	--	--	--	10	2	--	--	10	2
Canada	1	(2)	--	--	3	1	309	35	313	36
China, People's Republic of	185	43	--	--	1,417	286	--	--	1,602	329
France	--	--	--	--	3	2	--	--	3	2
Germany, West	662	334	--	--	1,883	500	24	21	2,569	855
Hong Kong	--	--	--	--	35	6	--	--	35	6
Italy	--	--	4	4	--	--	--	--	4	4
Japan	--	--	--	--	(2)	(2)	13	31	13	31
Korea, Republic of	--	--	--	--	466	17	--	--	466	17
Malagasy Republic	2,732	434	--	--	860	221	--	--	3,592	655
Malaysia	r 55	r 39	--	--	--	--	--	--	r 55	r 39
Mexico	44	8	--	--	63,136	1,418	(2)	(2)	63,180	1,426
Norway	89	11	--	--	2,241	290	--	--	2,330	301
Sri Lanka	--	--	165	45	2,822	681	--	--	2,987	726
Switzerland	--	--	--	--	--	--	36	22	36	22
Taiwan	--	--	--	--	60	14	--	--	60	14
U.S.S.R	--	--	--	--	165	27	--	--	165	27
Venezuela	--	--	--	--	(2)	(2)	--	--	(2)	(2)
Total	r 3,768	869	169	49	73,112	3,467	382	109	r 77,431	r 4,494
1974:										
Australia	--	--	--	--	11	2	--	--	11	2
Austria	--	--	--	--	20	4	--	--	20	4
Canada	--	--	46	2	21	1	1,281	118	1,348	121
China, People's Republic of	--	--	--	--	1,353	348	--	--	1,353	348
France	--	--	--	--	6	9	1	1	7	10
Germany, West	536	301	--	--	2,268	625	62	21	2,866	947
Hong Kong	--	--	--	--	139	30	--	--	139	30
Israel	--	--	--	--	(2)	(2)	--	--	(2)	(2)
Italy	--	--	--	--	9	14	--	--	9	14
Japan	--	--	--	--	1	3	18	49	19	52
Korea, Republic of	--	--	--	--	273	31	--	--	273	31
Malagasy, Republic	3,378	583	--	--	425	68	--	--	3,803	651
Malaysia	187	23	--	--	--	--	--	--	187	23
Mexico	--	--	--	--	63,294	1,495	--	--	63,294	1,495
Netherlands	--	--	--	--	3	1	(2)	1	3	2
Norway	--	--	--	--	2,447	363	--	--	2,447	363
South Africa, Republic of	7	1	--	--	13	2	--	--	20	3
Sri Lanka	84	20	336	117	2,403	677	--	--	2,823	814
Switzerland	--	--	--	--	--	--	162	103	162	103
Taiwan	--	--	--	--	409	81	--	--	409	81
U.S.S.R	548	75	--	--	2,842	498	--	--	3,390	573
United Kingdom	--	--	--	--	11	2	42	8	53	10
Total	4,740	1,003	382	119	75,948	4,254	1,566	301	82,636	5,677

r Revised.
[1] Includes only that received in raw-material form; excludes products made of graphite.
[2] Less than ½ unit.

WORLD REVIEW

World production of natural graphite increased in 1974, but the gain was not sufficient to keep pace with the growing international market. Production of amorphous graphite in Mexico and the Republic of Korea continued to be adequate. A critical shortage of Malagasy crystalline flake still remained. As a result, the overall situation in world markets changed little from that in 1972 and 1973.

India.—Geological Survey of India announced that a deposit of high-grade graphite estimated at 330,000 short tons had been found in the Idikki District.[7]

Malagasy Republic.—The continued tense political climate in the country as a whole, and particularly in the graphite-producing region and Tamatave, continued to affect production. Cyclone damage to the railroad and road networks continued to hamper transport of mined materials.

Norway.—A/S Skaland Grafitverk completed a new processing plant that gives a higher grade product and increases production.

Sri Lanka.—The State Graphite Corp. conducted feasibility studies on a new mine site at Rangala in the Yatiuantola district. Results indicated the mine can be worked on a commercial basis. Preliminary work was completed on another new mine at Ragedra in the Dodangaslanda district. A pilot plant was established in collaboration with the Ceylon Institute of Scientific and Industrial Research to investigate the beneficiation of lower grades of graphite. The Corporation negotiated with a U.S. company to set up a plant for manufacturing petroleum-based semicolloidal graphite lubricants, primarily for the Southeast Asia market.[8]

Table 7.—Graphite: World production, by country
(Short tons)

Country [1]	1972	1973	1974 [p]
Argentina	28	104	[e] 110
Austria	20,693	18,972	27,177
Brazil (marketable)	[r] 3,935	[e] 4,300	4,500
Burma	239	202	[e] 336
China, People's Republic of	33,000	33,000	33,000
Germany, West	12,509	14,909	[e] 15,400
Italy	852	4,587	[e] 2,740
Japan	940	[e] 880	[e] 880
Korea, North [e]	85,000	85,000	85,000
Korea, Republic of	44,939	48,065	[e] 50,000
Malagasy Republic	20,194	15,392	19,048
Mexico	60,748	72,082	[e] 75,000
Norway	[r] 9,412	7,359	[3] 10,526
Romania [e]	6,600	6,600	6,600
Sri Lanka	7,871	[4] 6,842	[4] 10,414
South Africa, Republic of	934	1,134	[e] 800
U.S.S.R.[e]	90,000	90,000	90,000
United States	W	W	W
Total	[r] 397,894	409,428	431,531

[e] Estimate. [p] Preliminary. [r] Revised. W Withheld to avoid disclosing individual company confidential data.

[1] In addition to the countries listed, Czechoslovakia, India, Southern Rhodesia, and the Territory of South-West Africa are believed to produce graphite, but available information is inadequate for formulation of reliable estimates of output levels.

[2] Data for year Apr. 1, 1974, through Mar. 31, 1975.

[3] Production of A/S Skaland Grafitverk only.

[4] Exports.

TECHNOLOGY

Although research efforts continued to be concentrated on manufactured graphite and its uses in 1974, several new developments occurred pertaining either to natural graphite or both natural and manufactured graphite.

Graphite fluoride continued to be studied. Careful temperature control in the range

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[7] Engineering and Mining Journal. V. 175, No. 12, February 1974, p. 143.

[8] Mining Journal. V. 284, No. 7284, Mar. 28, 1975, p. 229.

627±3° C resulted in the synthesis of poly (carbon monofluoride).[9] The white compound is stable in air to 600° C. Studies showed the compound is a superior solid lubricant under heavy loads, high temperatures, in oxidizing atmospheres, and under other extreme conditions.[10] Other work demonstrated a high potential for carbon monofluoride as a cathode material in high-energy batteries.[11]

A series of patents assigned to the Sagami Chemical Research Center (Japan) were issued on graphite-complex catalysts for chemical synthesis. The C_8K and the $C_{24}K$ complexes have a remarkable ability to absorb hydrogen, nitrogen, and methane. The observations suggest a parallel to the catalytic ammonia synthesis accomplished with graphite-$FeCl_3$-K complexes. Activity for hydrocarbon synthesis from CO and H_2 (producer gas) is also described. In addition, C_8K catalyzes the room-temperature addition of primary and secondary amines to dienes to give alkenylamines. Acetic acid was synthesized in high yield from methanol and CO over a graphite-$RhCl_3$-I_2 complex.[12]

The use of graphite as an additive in powder metallurgy assumed increasing importance when it appeared the automotive industry would make increased use of this fabrication technique. In another application, graphite not only supplies the carbon, but also functions as a lubricant in steel-alloy powders. Both of these applications require a crystalline flake material and should further aggravate the already tight supply of this material. Graphite use as a carbon additive is also increasing because of the growing use of electric furnaces by the steel industry. Graphite is favored over coke in this and other processes because of its lower sulfur content.

Refractory use of natural graphite increased, spurred by its cost advantage over substitute materials, and was more readily available than energy-intensive materials. Work on graphite continued, to increase its oxidation resistance and ease of application, and improve its refractory characteristics.[13]

Another area of major growth for natural graphite appeared to be in lubricants. Design engineers evaluated the properties of graphite and specified increased prelubrication for fabricating steel, forging, die casting, and powder metallurgy. Lengthened tool and die life and increased production were realized as well. An additional impetus to convert to water-based graphite lubricants was decreased air-pollution control problems caused by fuming of petroleum-based lubricants. The swing should be aided by the increasing costs of petroleum-derived lubricants. Graphite was also used as a lubricant in continuous casting, and its use in this application will grow as the number of continuous casting installations increase.

Rammed graphite molds (replacing sand molds) made titanium casting commercially feasible. The graphite molds gave excellent dimensional accuracy, and increased metal utilization from 17% to 58%.[14]

Graphite filament use continued to grow as increased numbers of aircraft secondary structures were designed to utilize the properties of the material. Applications continued to spread beyond the aerospace field. Sporting goods account for the major commercial use of graphite filament in such items as golf clubs, tennis rackets, fishing rods, and bicycle frames. Increased production and concurrent lower prices began to focus attention on industrial applications.

Development of metal-graphite composites continued. Based on earlier work done on liquid infiltration of aluminum-graphite composites, a similar approach to the fabrication of copper-graphite composites appreciably improved their physical characteristics. For example, copper-graphite was expected to maintain its room-temperature properties at temperatures near the melting point of copper. At higher temperatures, the use of beryllium-copper alloy was contemplated.

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[9] Lagow, R. J., R. B. Badachhape, J. L. Wood, J. L. Margrave. Synthesis of Superstoichiometric Poly (carbon monofluoride). J. Am. Chem. Soc., v. 96, No. 8, p. 2629–30, 1974.

[10] R. L. Fusaro. Organopolysiloxane—Bonded Graphite Fluoride as a Solid Lubricant. NASA Tech. Memo., NASA TN–D–8033, E–8298, 1974, 21 pp.

[11] Bauer, K. Tech. Rept. ECOM–3322, U.S. Army Electronics Command, Fort Monmouth, N.J. Hunger, H. F., and G. J. Heymark. Tech. Rept. ECOM–4047, 1972, pp. 34, U.S. Army Electronics Command, Fort Monmouth, N.J.

[12] Hughes, R. Heart Cut. Chemtech, September 1974, pp. 515–516.

[13] Parsons, J. R., and H. L. Rechter (assigned to Chicago Fire Brick Co.). Manufacture of High-Carbon Refractories Which Will Not Steam or Fume After Installation. U.S. Pat. 3,842,760 and 3,846,144, Oct. 22, 1974.

[14] Foundry Management & Technology. V. 103, No. 4, April 1975, p. 73.

Gypsum

By Avery H. Reed [1]

Activity in the gypsum industry declined in 1974 following the general depression in the building industries. Output of crude gypsum declined 12% to 12 million tons. Production of calcined gypsum declined 13% to 11 million tons. Sales of prefabricated products declined 14%, to 11.9 million tons. Imports decreased 3% to 7.4 million tons. Total value of gypsum products sold or used decreased 2% to $623 million.

Table 1.—Salient gypsum statistics
(Thousand short tons and thousand dollars)

	1970	1971	1972	1973	1974
United States:					
Active mines and plants [1]	108	107	108	112	116
Crude:[2]					
Mined	9,436	10,418	12,328	13,558	11,999
Value	$35,132	$39,057	$48,504	$56,650	$52,894
Imports for consumption	6,128	6,094	7,718	7,661	7,424
Calcined:					
Produced	8,449	9,526	12,005	12,592	10,993
Value	$132,047	$151,991	$195,862	$205,326	$205,713
Products sold (value)	$353,474	$435,257	$560,569	$632,809	$623,102
Exports (value)	$3,475	$4,214	$5,276	$7,360	$10,844
Imports for consumption (value)	$16,581	$16,332	$22,042	$21,937	$21,889
World: Production	56,868	58,421	[r] 64,470	67,858	66,109

[r] Revised.
[1] Each mine, calcining plant, or combination mine and plant is counted as one establishment.
[2] Excludes byproduct gypsum.

DOMESTIC PRODUCTION

Forty-four companies mined crude gypsum at 75 mines in 22 States. Of these, 62 were open pit and 13 were underground mines. Output of crude gypsum declined 12%, to 12 million tons. Leading States were California, Michigan, Iowa, Texas, and Oklahoma. These 5 States, with 31 mines, accounted for 60% of the total domestic production.

Leading companies were United States Gypsum Co. (13 mines); National Gypsum Co. (8 mines); Georgia-Pacific Corp. (7 mines); H.M. Holloway Inc. (1 mine); and The Flintkote Co. (3 mines). These 5 companies, operating 32 mines, produced 72% of the total crude gypsum.

Leading individual mines were U.S. Gypsum's Plaster City mine in Imperial County, Calif., H.M. Holloway's Lost Hills mine in Kern County, Calif., National Gypsum's Tawas mine in Iosco County, Mich., and U.S. Gypsum's Alabaster mine in Iosco County, Mich. These four mines accounted for 21% of the national total.

Thirteen companies calcined gypsum at 77 plants in 29 States. Output declined 13% to 11 million tons. Leading States were California, Texas, New York, and Iowa. These 4 States, with 26 plants, accounted for 37% of the total production.

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[1] Supervisory physical scientist, Division of Nonmetallic Minerals.

Leading companies were U.S. Gypsum Co. (23 plants); National Gypsum Co. (19 plants); Georgia-Pacific Corp. (10 plants); The Flintkote Co. (6 plants); and The Celotex Corp. (5 plants). These 5 companies, operating 63 plants, accounted for 85% of the total domestic output of calcined gypsum.

Leading individual plants were U.S. Gypsum's Plaster City plant in Imperial County, Calif.; Weyerhaeuser's Briar plant in Howard County, Ark.; U.S. Gypsum's Shoals plant in Martin County, Ind.; U.S. Gypsum's Stony Point plant in Rockland County, N.Y.; Georgia-Pacific's Acme plant in Hardeman County, Tex.; U.S. Gypsum's Fort Dodge plant in Webster County, Iowa; U.S. Gypsum's Jacksonville plant in Duval County, Fla.; National Gypsum's Savannah plant in Chatham County, Ga.; National Gypsum's Shoals plant in Martin County, Ind.; and U.S. Gypsum's Sweetwater plant in Nolan County, Tex. These 10 plants accounted for 25% of the national total.

In California, Occidental Petroleum Corp., Valley Nitrogen Producers Inc., and Collier Carbon & Chemical Corp. sold 463,000 tons of byproduct gypsum valued at $4,302,000 for use in agriculture.

The United States is the world's leading producer of gypsum, accounting for 18% of the total world output.

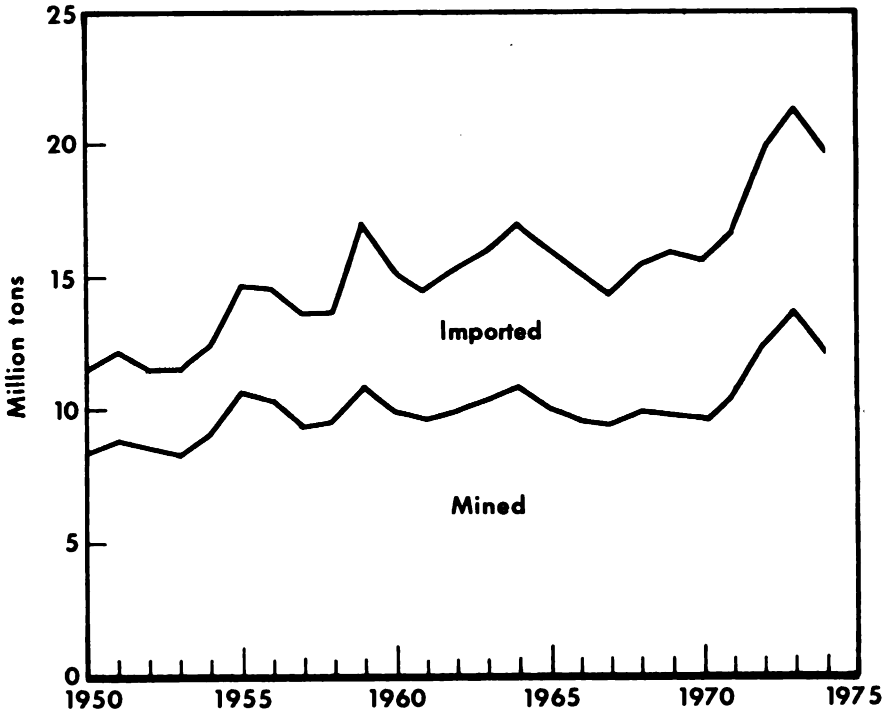

Figure 1.—Supply of crude gypsum in the United States.

Table 2.—Crude gypsum mined in the United States, by State

(Thousand short tons and thousand dollars)

State	1973			1974		
	Active mines	Quantity	Value	Active mines	Quantity	Value
Arizona	4	158	669	4	141	473
California	5	1,778	5,834	5	1,716	6,642
Colorado	4	151	568	5	191	800
Iowa	5	1,470	6,324	6	1,397	7,142
Michigan	5	1,882	8,538	5	1,482	7,258
Nevada	4	1,154	3,662	4	843	2,959
New Mexico	3	255	1,220	3	157	532
New York	3	525	3,369	3	364	2,942
Oklahoma	7	1,429	5,796	7	1,225	5,622
South Dakota	1	W	W	2	32	135
Texas	7	1,616	6,469	8	1,365	5,276
Utah	3	231	1,134	5	248	1,076
Wyoming	3	312	1,348	3	315	960
Other States[1]	15	2,597	11,719	15	2,523	11,077
Total	69	13,558	56,650	75	11,999	52,894

W Withheld to avoid disclosing individual company confidential data; included with "Other States."

[1] Includes Louisiana, Montana (1973), Virginia, and Washington, 1 mine each; Arkansas, Idaho, Indiana, Kansas, Montana (1974), and Ohio, 2 mines each; and Kansas (1973), 3 mines.

Table 3.—Calcined gypsum produced in the United States, by State

(Thousand short tons and thousand dollars)

State	1973			1974		
	Active plants	Quantity	Value	Active plants	Quantity	Value
California	7	1,309	14,870	7	1,123	16,242
Florida	3	642	8,219	3	547	9,045
Georgia	3	699	12,370	3	644	13,161
Iowa	5	975	16,982	5	896	15,634
Michigan	4	596	11,677	4	443	8,629
Nevada	3	541	8,648	3	383	6,374
New Jersey	4	587	6,727	4	549	7,753
New York	7	1,230	20,931	7	954	18,042
Ohio	3	434	5,227	3	379	6,272
Texas	7	1,349	25,610	7	1,096	22,657
Other States[1]	30	4,230	74,065	31	3,979	81,904
Total	76	12,592	205,326	77	10,993	205,713

[1] Includes Arizona, Arkansas (1973), Colorado, Connecticut, Delaware, Illinois, Massachusetts, Montana, New Hampshire, Pennsylvania, and Washington, 1 plant each; Arkansas (1974), Kansas, Louisiana, Maryland, New Mexico, Oklahoma, Utah, Virginia, and Wyoming, 2 plants each; and Indiana, 3 plants.

CONSUMPTION AND USES

Apparent consumption of crude gypsum (production plus imports minus exports) decreased 8% to 19.4 million tons. Imports were 38% of consumption. Apparent consumption of calcined gypsum declined 13% to 11.0 million tons.

Stocks of crude gypsum at mines and plants at yearend were 3.6 million tons. Of this, 2.3 million tons or 65% was at plants in coastal States.

Of the total gypsum products sold or used, 5.9 million tons (31%) was sold uncalcined. Of the total uncalcined gypsum, 4.1 million tons (69%) was used for portland cement and 1.7 million tons (29%) was used in agriculture. The leading sales regions for gypsum used in cement were the West South-Central, Middle Atlantic, and East North-Central, which accounted for 51% of the total. For agricultural gypsum, the Pacific sales region accounted for 85% of the total.

Of the total calcined gypsum, 93% was used for prefabricated products and 7% for plasters. Of the prefabricated products, 71% was regular wallboard, 22% was fire-resistant Type X wallboard, and only 2% was lath. Of the regular gypsumboard, 86% was of the ½-inch type. The leading sales regions for prefabricated products were the South Atlantic, the East North-Central, and the Pacific, which accounted for 50% of the total. For plaster, the East North-Central, South Atlantic, and Middle Atlantic accounted for 62% of the total.

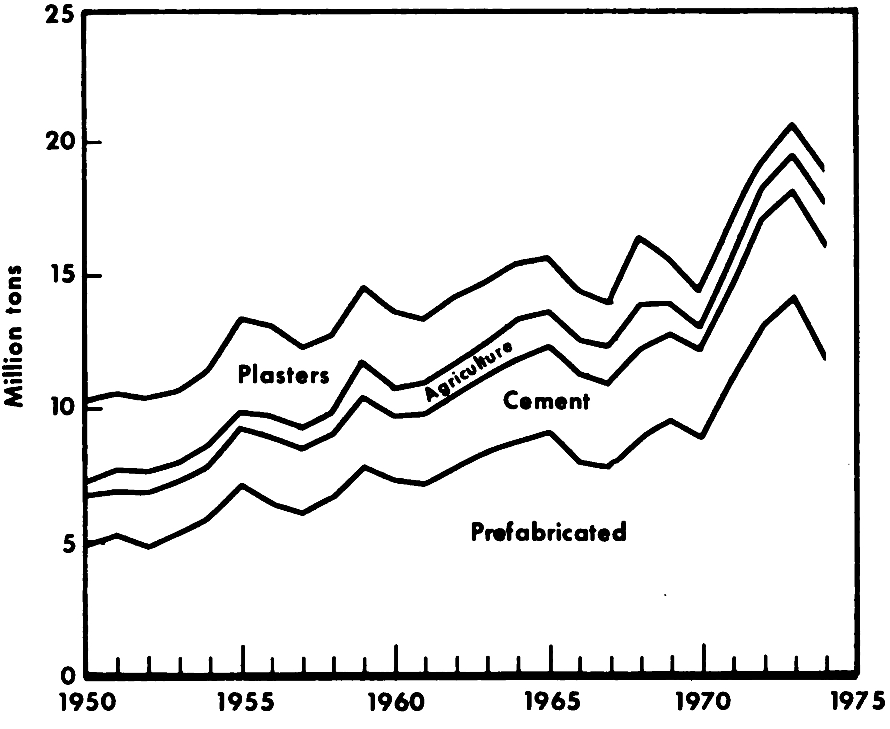

Figure 2.—Sales of gypsum products, by use.

Table 4.—Gypsum products (made from domestic, imported and byproduct gypsum) sold or used in the United States, by use

(Thousand short tons and thousand dollars)

Use	1973 Quantity	1973 Value	1974 Quantity	1974 Value
Uncalcined:				
Portland cement	4,148	22,189	4,058	24,122
Agriculture	1,453	7,402	1,671	12,728
Other	117	1,479	123	1,897
Total [1]	5,719	31,070	5,852	38,747
Calcined:				
Industrial plaster	353	14,181	326	14,626
Building plaster:				
Regular base coat	292	7,433	215	6,467
Mill-mixed base coat	166	5,607	142	5,412
Veneer plaster	88	5,366	81	5,174
Other [2]	224	5,558	191	6,610
Total [1]	771	23,694	629	23,664
Prefabricated products [3]	13,793	563,594	11,886	546,065
Total calcined	14,917	601,739	12,841	584,355
Grand total	20,636	632,809	18,693	623,102

[1] Data may not add to totals shown because of independent rounding.
[2] Includes gauging, molding, and Keene's cement, roof deck concrete, and other uses.
[3] Includes weight of paper, metal, or other materials.

Table 5.—Prefabricated products sold or used in the United States, by product

Product	1973			1974		
	Thousand square feet	Thousand short tons [1]	Value (thousands)	Thousand square feet	Thousand short tons [1]	Value (thousands)
Lath:						
⅜-inch	351,987	272	$11,218	247,053	194	$9,448
½-inch	16,168	15	553	11,503	11	457
Total [2]	368,155	286	11,771	258,556	205	9,905
Veneer base	399,373	368	15,710	344,048	316	14,818
Sheathing	337,443	323	12,921	250,737	240	11,056
Regular gypsumboard:						
⅜-inch	1,099,064	843	36,010	972,624	769	36,435
½-inch	9,570,318	8,582	326,133	8,049,276	7,204	310,074
⅝-inch	295,563	322	12,698	268,139	265	10,914
1-inch	25,158	50	2,414	24,845	45	2,509
Other [3]	109,495	97	4,193	124,675	110	5,492
Total [2]	11,099,598	9,893	381,448	9,439,559	8,393	365,425
Type X gypsumboard	2,574,516	2,721	116,401	2,446,306	2,570	122,563
Predecorated wallboard	214,369	191	22,900	164,642	156	20,046
Other	10,571	11	2,443	6,502	6	2,252
Grand total [2]	15,004,025	13,798	563,594	12,910,350	11,886	546,065

[1] Includes weight of paper, metal, or other material.
[2] Data may not add to totals shown because of independent rounding.
[3] Includes ¼-inch, 5/16-inch, ⅝-inch, and ¾-inch gypsumboard.

PRICES

The value of crude gypsum increased from $4.18 per ton in 1973 to $4.41 in 1974. The value of calcined gypsum increased from $16.31 to $18.71. The average value of byproduct gypsum sold was $9.29 per ton.

The average value of gypsum products increased from $30.67 in 1973 to $33.33 per ton in 1974. Prefabricated products were valued at $45.94, industrial plasters at $44.80, building plasters at $37.63, and uncalcined products at $6.62 per ton.

Quoted prices for gypsum are published monthly in the Engineering News-Record. Prices at yearend showed a wide range, based on delivered prices. Regular ½-inch wallboard prices ranged from $40 per thousand square feet at Dallas to $93 at Chicago. Prices for plaster ranged from $52 per ton at St. Louis to $71.25 at Boston.

FOREIGN TRADE

The gypsum industry depends on imports. In 1974, 38% of the crude gypsum supply was imported. Imports were from Canada (77%), Mexico (16%), Jamaica, Dominican Republic, Morocco, the United Kingdom, Venezuela, and Italy. Imports decreased 3% to 7.4 million tons. Exports of crude gypsum were 14,210 tons.

Table 6.—U.S. exports of gypsum and gypsum products

(Thousand short tons and thousand dollars)

Year	Crude, crushed or calcined		Other manufactures n.e.c.	Total value
	Quantity	Value	Value	
1972	51	2,582	2,694	5,276
1973	63	3,135	4,225	7,360
1974	123	3,910	6,934	10,844

Table 7.—U.S. imports for consumption of gypsum and gypsum products

(Thousand short tons and thousand dollars)

Year	Crude		Ground or calcined		Alabaster manufactures[1]	Other manufactures n.e.c.	Total value
	Quantity	Value	Quantity	Value	Value	Value	
1972	7,718	18,342	2	152	1,950	1,598	22,042
1973	7,661	17,572	2	123	1,914	2,328	21,937
1974	7,424	17,602	2	107	1,976	2,204	21,889

[1] Includes imports of jet manufactures, which are believed to be negligible.

Table 8.—U.S. imports for consumption of crude gypsum, by country

(Thousand short tons and thousand dollars)

Country	1973		1974	
	Quantity	Value	Quantity	Value
Canada	5,944	14,100	5,727	14,026
Dominican Republic	177	648	230	924
Italy	(1)	9	(1)	12
Jamaica	334	867	238	546
Mexico	1,206	1,948	1,185	1,766
Morocco	--	--	23	83
United Kingdom	--	--	18	44
Venezuela	--	--	3	201
Total	7,661	17,572	7,424	17,602

(1) Less than ½ unit.

WORLD REVIEW

Canada.—Canada was the second leading producer of crude gypsum, accounting for 12% of the world total. About three-fourths of Canadian gypsum is exported to the United States, mainly from Nova Scotia. This exported gypsum is mined by Canadian subsidiaries of United States gypsum companies.

The Flintkote Co. of Canada Ltd. mined gypsum in Newfoundland. Active producers in Nova Scotia were Little Narrows Gypsum Co. Ltd.; Georgia-Pacific Corp.; Fundy Gypsum Co. Ltd.; National Gypsum Co. Can.; and Domtar Construction Materials Ltd. Canadian Gypsum Co. Ltd. and Canada Cement Lafarge Ltd. mined gypsum in New Brunswick. Canadian Gypsum Co. Ltd. and Domtar Construction Materials Ltd. operated underground gypsum mines in Ontario. Westroc Industries Ltd. and Domtar Construction Materials Ltd. mined gypsum in Manitoba. Western Gypsum Mines Ltd. mined gypsum in British Columbia.

Egypt, Arab Republic of.—Gypsum deposits recently discovered at Gharbanian were estimated to contain 12 million tons, a 30-year supply for Egypt.

France.—France was the third leading gypsum producing country, with 10% of world production.

Spain.—Spain ranked fifth in world gypsum production with 7% of the total.

U.S.S.R.—The U.S.S.R. produced 7% of the world's gypsum and ranked fourth.

Table 9.—Gypsum: World production, by country
(Thousand short tons)

Country [1]	1972	1973	1974 p
North America:			
Canada (shipments) [2]	8,099	8,389	8,235
Dominican Republic	r e 273	253	e 254
Ecuador	e (3)	(3)	e (3)
El Salvador e	7	7	7
Guatemala e	9	9	9
Honduras	17	15	9
Jamaica	486	393	296
Mexico	1,651	1,669	1,529
Nicaragua	29	e 39	e 39
United States	12,328	13,558	11,999
South America:			
Argentina	r 566	501	e 500
Bolivia [4]	3	1	4
Brazil	262	388	e 441
Chile	r 141	98	149
Colombia	r 244	248	345
Paraguay	r 18	12	16
Peru	78	e 78	e 78
Venezuela	95	187	181
Europe:			
Austria [2]	838	960	886
Belgium	117	126	113
Bulgaria	165	182	198
Czechoslovakia	552	637	e 661
France [2]	6,826	6,788	6,856
Germany, East e	r 375	r 375	375
Germany, West (marketable)	r 2,958	3,250	e 3,500
Greece	441	463	463
Ireland	r 425	481	423
Italy e	3,858	3,858	3,858
Luxembourg	5	6	6
Poland e	937	937	937
Portugal	149	e 149	e 149
Spain	4,546	4,928	e 4,850
Switzerland e	r 110	110	110
U.S.S.R. e	5,181	5,181	5,181
United Kingdom	r 3,823	4,243	3,434
Yugoslavia	298	283	276
Africa:			
Algeria e	193	193	193
Angola	92	51	44
Egypt, Arab Republic of	r 471	577	616
Ethiopia	5	--	13
Kenya [2] e	110	110	110

See footnotes at end of table.

Table 9.—Gypsum: World production, by country—Continued

(Thousand short tons)

Country [1]	1972	1973	1974 [p]
Africa—continued			
Libya	4	4	4
Mauritania [4]	--	2	9
Niger	[r] 2	[r] [e] 2	2
South Africa, Republic of	462	533	614
Sudan [2] [e]	[r] 33	[r] 33	33
Tanzania	[r] 16	14	23
Zambia	--	([3])	4
Asia:			
Burma	16	17	18
China, People's Republic of [e]	661	694	717
Cyprus	[r] 22	55	28
India	1,218	974	1,157
Indonesia [e]	9	9	9
Iran	2,646	[e] 2,646	[e] 2,646
Israel	[r] 132	165	220
Japan	513	417	368
Jordan	33	33	33
Korea, Republic of	--	[e] 165	353
Lebanon	[r] [e] 22	11	14
Mongolia [e]	28	28	28
Pakistan	170	196	207
Philippines	94	112	139
Saudi Arabia [e]	50	50	50
Syrian Arab Republic [e]	17	17	17
Taiwan	[r] 6	6	4
Thailand	99	260	344
Turkey	371	395	394
Vietnam, South [e]	8	8	8
Oceania: Australia	[r] 1,057	1,279	[r] 1,323
Total	[r] 64,470	67,858	66,109

[e] Estimate. [p] Preliminary. [r] Revised.

[1] Gypsum is also produced in Cuba and Romania, but production data are not available.

[2] Includes anhydrite.

[3] Less than ½ unit.

[4] Net exports.

TECHNOLOGY

Planned developments to remove sulfur from stack gases by using lime or limestone could result in the accumulation of large quantities of impure byproduct gypsum. The problems of disposal or potential uses of this material are being studied.

Helium

By Ronald F. Balazik [1]

Sales of high purity helium (99.995% purity) in the United States during 1974 totaled 539 million cubic feet, an increase of over 8%.[2] The Bureau of Mines sold 31% of this total, and private industry sales accounted for the remaining amount. High purity helium exports, all by private industry, totaled 160 million cubic feet during 1974. The Bureau of Mines f.o.b. plant price for high purity helium during 1974 remained at $35 per thousand cubic feet, but private industry prices rose from an average of $21 to an average of $23 per thousand cubic feet.

On May 3, 1974, the Supreme Court declined to review the decision of the U.S. Court of Appeals under which the U.S. Department of the Interior terminated its helium conservation contracts in late 1973 with the National Helium Corp., Phillips Petroleum Co., and Cities Service Helex, Inc. Final settlement by the three contractors of claims arising from the termination of the contracts is still pending.

On December 3, 1974, a trial judge of the U.S. Court of Claims ruled that a fourth contractor, Northern Helex Co., was entitled to $78 million in damages because the Government had breached its helium purchase contract with the company. This ruling is subject to review by the full Court of Claims and possible appeal to the U.S. Supreme Court.

A bill to authorize the Secretary of the Interior to conserve and store helium was introduced in the House of Representatives, U.S. Congress, on June 6, 1974. It directed the Secretary of the Interior to store and redeliver helium produced in private helium extraction plants at no expense to the producer. The bill was not enacted into law.

DOMESTIC PRODUCTION

A total of 11 plants in the United States had the capability to extract helium during 1974. Nine of the plants were owned by private industry, and the remaining two were owned by the Federal Government and operated by the Bureau of Mines. An additional plant was being constructed near Redrock, N. Mex., by Western Helium Co. to replace its dismantled plant near Navajo, Ariz.

During 1974, total helium extracted from natural gas declined about 72% to 883 million cubic feet following the termination of helium conservation storage contracts in December 1973. However, high purity helium output increased 8% to 699 million cubic feet. Approximately 21% of the total helium extracted was crude helium[3] and 79% was high purity helium produced for sale. The Bureau of Mines accounted for 92% of crude helium production and 24% of high purity output. The remaining crude and high-purity helium was extracted by private industry.

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[1] Physical scientist, Division of Petroleum and Natural Gas.

[2] All helium statistics in this chapter are reported in terms of contained helium measured at 14.7 pounds per square inch absolute and 70° F.

[3] Helium mixed with various quantities of other light gases, mostly nitrogen.

Table 1.—Helium extracted from natural gas in the United States
(Thousand cubic feet)

	1970	1971	1972	1973	1974 p
Crude helium:[1]					
Extracted at Bureau of Mines plants	429,400	504,406	262,197	175,976	169,414
Extracted at private industry plants	3,523,800	3,479,226	3,204,806	r 2,381,971	15,073
Total	3,953,200	3,983,632	3,467,003	r 2,557,947	184,487
High purity helium:[2]					
Extracted at Bureau of Mines plants	230,700	173,626	173,526	180,114	168,662
Extracted at private industry plants	416,500	403,152	453,675	467,102	[3] 530,312
Total	647,200	576,778	627,201	647,216	698,974
Grand total	4,600,400	4,560,410	4,094,204	r 3,205,163	883,461

p Preliminary. r Revised.

[1] Excludes crude helium purified after interplant transfer.

[2] Includes only those quantities produced for sale; quantities entering conservation storage system after purification are included under crude helium.

[3] Includes 28,657 thousand cubic feet purified at the Bureau of Mines Keyes plant for National Helium Corp.

Table 2.—Ownership and location of helium extraction plants in the United States, 1974

Category and owner or operator	Location	Type of production
Government-owned:		
Bureau of Mines	Exell, Tex	Crude helium.
Do	Keyes, Okla	Crude and high purity helium.
Private industry:		
Alamo Chemical-Gardner Cryogenics	Elkhart, Kans	High purity helium.
Cities Service Cryogenics, Inc	Scott City, Kans	Crude helium.[1] [2]
Cities Service Helex, Inc	Ulysses, Kans	Crude and high purity helium.[3]
Kansas Refined Helium Co	Otis, Kans	High purity helium.
Kerr-McGee, Corp	Navajo, Ariz	Do.
National Helium Corp	Liberal, Kans	Crude helium.[1]
Northern Helex Co	Bushton, Kans	Do.[1] [4]
Phillips Petroleum Co	Dumas, Tex	Do.[1]
Do	Hansford County, Tex	Do.[1]

[1] Ceased deliveries to Bureau of Mines helium conservation storage system in late 1973.

[2] Output is piped to Cities Service Helex, Inc., plant at Ulysses, Kans. for purification.

[3] Purifies crude helium piped from Cities Service Cryogenics, Inc., plant at Scott City, Kans.

[4] Output is transported in highway semitrailers to other plants for purification.

Construction work was completed on a helium-enriching unit at the Bureau of Mines Exell plant during 1974. The work was accomplished under a contract with M. W. Kellogg Co. and its subcontractor, Control Automation. Principal work included piping and instrument calibration, pressure testing, and insulation of cold boxes. The enriching unit was tested and operational at yearend.

Several construction efforts were also completed or planned at the Bureau of Mines Keyes plant during 1974. Compressors at the plant were overhauled, and a new aluminum heat exchanger tube bundle was fabricated. In addition, a construction contract for helium trailer filling facilities at the Keyes plant was awarded to Hallmark Builders, Inc.

Table 3.—Summary of Bureau of Mines helium plant and Amarillo shipping terminal operations
(Thousand cubic feet)

	1972	1973	1974[p]
Supply:			
Inventory at beginning of period[1]	11,474	16,142	8,632
Helium extracted:[2]			
Exell plant:			
Crude	99,392	60,525	35,036
High purity	--	--	--
Total Exell plant	99,392	60,525	35,036
Keyes plant:			
Crude	162,805	115,451	134,378
High purity[3]	176,469	181,334	170,194
Total Keyes plant	339,274	296,785	304,572
Total extracted	438,666	357,310	339,608
Helium returned in containers (net)	2,586	3,539	2,935
Total supply	452,726	376,991	351,175
Disposal:			
Sales of high purity helium	173,526	180,114	168,662
Net deliveries to helium conservation system[4]	263,058	188,245	173,222
Inventory at end of period[1]	16,142	8,632	9,291
Total disposal	452,726	376,991	351,175

[p] Preliminary.

[1] At Exell and Keyes plants and at Amarillo shipping terminal.

[2] Excludes conservation helium produced from native gas withdrawal wells at Cliffside field which have been invaded by stored helium.

[3] Excludes 28,657 thousand cubic feet purified for the account of National Helium Corp. after withdrawal from that company's account in the Bureau of Mines conservation storage system.

[4] Excludes return of conservation helium produced as indicated in footnote 2 to conservation storage system.

CONSUMPTION AND USES

Domestic consumption of helium during 1974 was primarily for purging and pressurizing rockets and spacecraft, research, welding, maintenance of controlled atmospheres, leak detection, and cryogenics. Demand occurred principally in the Pacific and Gulf Coast States.

Sales of high purity helium in the United States increased about 8% in 1974. However, Bureau of Mines helium sales, which accounted for 31% of domestic sales, decreased approximately 6% during the year owing to a decline in utilization for purging and pressurizing rockets and spacecraft.

Approximately 52% of Bureau of Mines sales in 1974 were made to Federal agencies, which are required by law to purchase all of their major helium requirements from the U.S. Department of the Interior. The Bureau of Mines f.o.b. plant price, which is set at $35 per thousand cubic feet for the purpose of financing the long-range helium conservation program, was not competitive with the 1974 average private f.o.b. plant price of $23 per thousand cubic feet.

Remaining Bureau sales in 1974 were through purchases by Federal agencies from private distributors under General Services Administration contracts, which required the distributors to purchase equivalent quantities from the Bureau of Mines. These contracts made relatively small quantities of helium readily available to Federal installations and reduced freight charges for small purchases. The proportion of Bureau helium sales distributed in this manner increased 10% in 1974.

All helium sold by the Bureau of Mines was shipped in gaseous form in cylinders, highway semitrailers, or railway tank cars. Private industry plants shipped helium in both gaseous and liquid form. Much of the helium transported in liquid form was delivered by semitrailers and containerized dewars to distribution centers, where most of the product was gasified and compressed into small cylinders and trailers for delivery to consumers.

Table 4.—Total sales of high-purity helium in the United States
(Million cubic feet)

Year	Quantity
1970	[e] 542
1971	447
1972	489
1973	497
1974	[p] 539

[e] Estimate. [p] Preliminary.

Table 5.—Bureau of Mines sales of high purity helium, by recipient
(Thousand cubic feet)

	1972	1973	1974 [p]
Federal agencies:			
Atomic Energy Commission [1]	17,447	17,627	21,169
Department of Defense	61,578	47,766	45,432
National Aeronautics and Space Administration	35,775	34,739	13,684
National Weather Service	2,940	2,767	2,957
Other [2]	3,346	3,581	4,298
Total Federal agencies	121,086	106,480	87,540
Non-Federal customers [3]	52,440	73,634	81,122
Grand total	173,526	180,114	168,662

[p] Preliminary.

[1] Became part of Energy Research and Development Administration in 1974.

[2] Includes quantities used by Bureau of Mines.

[3] Most of this was purchased in bulk by commercial firms, repackaged in smaller containers, and then sold to Federal installations under contract arrangements with the General Services Administration.

CONSERVATION

Helium held in the Bureau of Mines conservation storage system, which includes the conservation pipeline network as well as the Cliffside gasfield near Amarillo, Tex. increased 1% during 1974. Of the 38,279 million cubic feet in storage, over 97% was held for the Bureau's conservation program. The remaining amount was stored under contract for private producers. All of the net addition to the helium conservation system was accounted for by deliveries from Bureau plants. Although one company (Cities Service Helex, Inc.) made some deliveries for its own future use, helium held for private producers own accounts decreased by 8.7% during the year.

The conservation storage system contains crude helium purchased by the Bureau of Mines under contracts entered into in 1961 and continued under court orders obtained during 1971 and early 1973 by Cities Service Helex, Inc., National Helium Corp., and Phillips Petroleum Company. As a result of the decision of the U.S. Court of Appeals for the Tenth Circuit in October, 1973 crude helium deliveries to the Bureau from Cities Service Helex, Inc., and National Helium Corp. ceased on November 12, 1973. However, Phillips Petroleum Co. opted to continue helium storage deliveries for its own account pending the outcome of negotiations on a long-term storage contract. These negotiations were unsuccessful and Phillips Petroleum Co. ceased deliveries for storage on December 12, 1973.

Table 6.—Summary of Bureau of Mines helium conservation system[1] operations

(Thousand cubic feet)

	1972	1973	1974 p
Helium in conservation storage system at beginning of period:			
Stored under Bureau of Mines conservation program	31,635,987	34,628,600	37,110,126
Stored under contract for private producers' own accounts	527,113	1,002,314	1,091,004
Total	32,163,050	35,630,914	38,201,130
Input to system:			
Net deliveries from Bureau of Mines plants[2]	263,058	188,245	173,222
Acquired from private industry conservation plants	2,729,605	r 2,293,281	--
Stored under contract for private producers' own accounts	583,748	163,110	15,073
Total	3,576,411	r 2,644,636	188,295
Redelivery of helium stored under contract for private producers' own accounts	108,547	74,425	110,090
Net addition to system	3,467,864	r 2,570,211	78,205
Helium in conservation storage system at end of period:			
Stored under Bureau of Mines conservation program	34,628,600	r 37,110,126	37,283,348
Stored under contract for private producers' own accounts	1,002,314	r 1,091,004	995,987
Total	35,630,914	r 38,201,130	38,279,335

p Preliminary. r Revised.

[1] Includes conservation pipeline system and Cliffside field.

[2] Excludes return to system of conservation helium produced from native gas withdrawal wells at Cliffside field which have been invaded by stored helium.

Table 7.—Helium purchased for Bureau of Mines conservation storage

(Thousand cubic feet)

Company	Helium delivered		
	1972	1973	1974
Cities Service Helex, Inc.[1]	699,048	r 515,876	--
National Helium Corp.[1]	1,107,898	1,011,238	--
Northern Helex, Co.[2]	--	--	--
Phillips Petroleum Co.[1]	922,659	766,167	--
Total	2,729,605	r 2,293,281	--

r Revised.

[1] Deliveries from these companies accepted in compliance with order of the Federal District Court for the State of Kansas after 8:00 a.m., Mar. 28, 1971, when termination provisions of these companies' helium conservation contracts were to have taken effect. This injunction was reversed on appeal in Oct. 1973, and the acceptance of helium for conservation storage ceased on Nov. 12, 1973.

[2] This company ceased delivery of helium for Bureau of Mines conservation programs as of 8:00 a.m., Mar. 28, 1971.

Table 8.—Deliveries and withdrawals of crude helium stored for private companies' own account in the Bureau of Mines conservation storage system, 1974

(Thousand cubic feet)

Owner	Plant location	Delivered	Withdrawn	Net
Cities Service Helex, Inc	Ulysses, Kans	[1] 15,073	[1] 53,098	—38,025
National Helium Corp	Liberal, Kans	--	28,657	[2] —28,657
Phillips Petroleum Co	Dumas, Tex Hansford County, Tex	--	28,336	—28,336
Total		15,073	110,091	—95,018

[1] Includes some helium stored for the account of Cities Service Cryogenics, Inc., which pipes its output to Cities Service Helex, Inc., for purification.

[2] Purified by the Bureau of Mines Keyes plant for the account of National Helium Corp.

RESOURCES

As of December 31, 1974, proved and probable helium resources in the United States were estimated to be 244.6 billion cubic feet. These resources include proved and probable helium reserves (in natural gas with a minimum helium content of 0.3%) estimated at 110.7 and 41.8 billion cubic feet, respectively. The remaining resource base includes 38.3 billion cubic feet of helium in the Bureau of Mines conservation storage system and 53.8 billion cubic feet of helium in proved gas reserves with a helium content of less than 0.3%.

A total of 88 gasfields in 10 States contain proved and probable helium reserves. The bulk of these reserves (about 90%) are in only five gasfields: The Tip Top field in Wyoming; the Hugoton field in Kansas, Oklahoma, and Texas; the Keyes field in Oklahoma; and the West Panhandle field and Cliffside field in Tex. Helium reserves in the Tip Top field were revised upward during 1974. Approximately 64% of the proved and probable reserves were in fields under production at yearend. Only about 9% of the helium-rich natural gas produced was processed for helium extraction, while helium in the remaining helium-rich gas output was wasted incidentally to the consumption of the gas.

Bureau of Mines efforts to identify new domestic and foreign helium resources continued during 1974. A total of 406 natural gas samples from 18 States and 5 foreign countries (Australia, Ethiopia, the Netherlands, Norway, and Taiwan) were collected and analyzed for helium content during the year. None of the samples indicated the presence of significant amounts of helium.

FOREIGN TRADE

High purity helium exports, all by private companies, increased approximately 7% in 1974 (compared with 9% in 1973). The exports comprised 32% of private industry sales and 24% of all high purity helium sales. Most of the exports were shipped to Western Europe.

Table 8.—Exports of high-purity helium from the United States
(Million cubic feet)

Year	Quantity
1970	[e] 105
1971	130
1972	138
1973	150
1974	[p] 160

[e] Estimate. [p] Preliminary.

WORLD REVIEW

The production of helium outside the United States totaled an estimated 140 million cubic feet in 1974. Canada produced about 35 million cubic feet from a plant in Saskatchewan, primarily for export to Japan and other Asian countries. A plant near Paris, France, produced about 10 million cubic feet of helium as a byproduct of nitrogen removal operations. The U.S.S.R. and other countries of Eastern Europe extracted an estimated 95 million cubic feet of helium during the year.

During 1974, plans were announced for a prototype helium extraction plant to be constructed in Alberta Province, Canada. The $300,000 plant is designed to recover 0.05% to 0.20% helium from natural gas by utilizing a diffusion process. Construction of the plant will be financed entirely by the Alberta government, but plant operations will be carried out by Alberta Helium, which is a new company composed of the provincial government, Trans Canada Pipelines, and Alberta Southern Gas. The plant is expected to process 2 million cubic feet of natural gas per day by 1977. Data obtained through plant operations will be used to determine the feasibility of a full-scale plant.

The construction of a nitrogen and helium extraction plant at Ostrow in southwestern Poland was nearing completion by yearend 1974. Petrocarbon Developments Ltd., a British firm, was building the plant under a contract with the Polish Government. When completed in 1975, the plant will process natural gas containing 45% nitrogen and 0.4% helium. The plant is expected to produce 150 million cubic feet of high purity helium per year.

Construction of the Republic of South Africa's first helium plant reportedly was completed in late 1974. The plant, located near Johannesburg, will extract helium from natural gas discovered in the Orange Free State goldfields.

TECHNOLOGY

During 1974, the world's first closed-cycle helium turbine was prepared for commissioning tests at a district heating plant in Oberhausen, West Germany. Although it will be operated as a commercial heating and electric power generation unit, the turbine is part of a long-range research program to develop a direct-cycle nuclear generating system employing a high-temperature gas-cooled reactor (HTGR). The Oberhausen project, a joint venture of West Germany industry and Government, will also provide the first mechanical life test of helium turbines functioning over a long period of time as part of an operational power station. Design and construction of the plant was the responsibility of G.H.H. Sterkrade and Kraftwerk Union.

General Atomic Co., jointly owned by Gulf Oil Corp. and the Royal Dutch-Shell Group, continued studies of helium gas turbines during 1974 for the Energy Research and Development Administration. The studies will assess the commercial feasibility of developing a helium-cooled nuclear reactor and employing the same helium in a closed cycle to drive the gas-turbine generator. This would eliminate the steam-turbine cycle ordinarily used in powerplants and allow heat rejection to take place directly to air in dry cooling towers, eliminating thermal pollution of streams and allowing utility companies more flexibility in picking powerplant sites. The gas turbines themselves could be located inside the same containment vessel that housed the reactor core, thus offering a capital cost savings.

During 1974, Air Products Ltd. (the United Kingdom) commissioned a cryogenic road tanker with a capacity of 11,000 U.S. gallons to carry liquid helium. The tanker reportedly is the largest of its kind in the world.

Iron Ore

By F. L. Klinger [1]

World production of iron ore in 1974 was estimated at 879 million tons,[2] about 5% more than in 1973. World exports increased about 8% to an estimated 395 million tons, of which about 82% was oceanborne. Imports of iron ore reported by the major consuming countries in 1974 included 140 million tons by Japan, 135 million tons by member countries of the European Coal and Steel Community (ECSC),[3] and 48 million tons by the United States. World consumption of iron ore probably increased in 1974; although consumption fell in some countries, including the United States and the United Kingdom, it rose in others, including Japan and West Germany. In general, demand for iron and steel was close to the 1973 levels.

World output of iron ore pellets was estimated at 157 million tons in 1974. While this was only about 5% more than in 1973, growth of production capacity over the longer term will continue to be relatively high because many new plants were under construction or planned. Worldwide, at least 80 million tons of new production capacity was expected to be installed by 1978. More than half of this capacity will be built in the United States and Brazil.

An increasing number of direct-reduction projects were evident in 1974, and growth in this sector appeared to be more rapid than the development of new pelletizing capacity. About 30 million tons of production capacity for sponge iron was expected to be installed worldwide by 1978. Installed capacity in 1974 amounted to about 5 million tons. The largest new projects were being located in countries having abundant domestic supplies of low-cost natural gas, such as Iran, Indonesia, and the U.S.S.R. Domestic reserves of iron ore were of secondary importance.

Iron ore prices rose significantly in 1974. Increases of up to 50% occurred in some countries, but the average increase in value of iron ore shipments was probably 15% to 25%. Further price increases were expected in 1975 as costs of production and fuels continued to rise. Railway and lake freight rates increased in the United States during 1974. Ocean freight rates, however, declined during the last half of the year as more vessels were diverted from the petroleum trade.

Vessel cargoes of more than 250,000 tons of iron ore were loaded in Brazil during 1974. The only port capable of receiving cargoes of this size appeared to be in Japan, although 200,000-ton cargoes could be accommodated at two ports in western Europe. The relatively shallow drafts available in U.S. ports continued to restrict the maximum size of incoming iron ore cargoes to about 65,000 tons. In the United States, several more 1,000-foot, self-unloading iron ore carriers were ordered for service on the Great Lakes.

The potentially high cost of environmental controls was illustrated in 1974 by a proposal of Reserve Mining Co., a major U.S. producer of iron ore pellets, to shift its tailings discharge from Lake Superior to an on-land site, add air pollution controls, and change its production process at an aggregate cost of $242 million.

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[1] Physical scientist, Division of Ferrous Metals.

[2] Unless otherwise stated, the unit of weight used in this chapter is the long ton of 2,240 pounds.

[3] Excluding ore containing less than 42% iron, which is normally imported from France by Belgium, Luxembourg, and West Germany. Imports of French ore by the latter countries in 1974 totaled 16.8 million tons.

Table 1.—Salient iron ore statistics

(Thousand long tons and thousand dollars)

	1970	1971	1972	1973	1974
United States:					
Iron ore (usable,[1] less than 5% Mn):					
Production [2]	89,760	80,762	75,434	87,669	84,355
Shipments [3]	87,176	77,106	77,884	90,654	84,985
Value [3]	941,788	891,001	950,365	1,163,710	1,388,447
Average value at mines per ton	$10.80	$11.55	$12.20	$12.84	$16.34
Exports	5,492	3,061	2,095	2,747	2,323
Value	$67,898	$38,147	$26,776	$37,922	$35,148
Imports for consumption	44,891	40,124	35,761	43,296	48,029
Value	$479,518	$450,644	$415,934	$533,488	$696,298
Consumption (iron ore and agglomerates)	131,571	116,196	126,943	146,922	133,160
Stocks Dec. 31:					
At mines	15,316	17,653	14,679	10,876	9,405
At consuming plants	52,781	57,738	50,061	45,990	45,247
At U.S. docks	3,408	3,424	2,612	3,053	3,272
Manganiferous iron ore (5% to 35% Mn): Shipments	329	177	131	181	201
World: Production	757,013	774,677	r 765,465	r 836,442	879,414

r Revised.

[1] Direct shipping ore, concentrates, agglomerates, and byproduct ore (mainly pyrite cinder and agglomerates).

[2] Includes byproduct ore.

[3] Excludes byproduct ore.

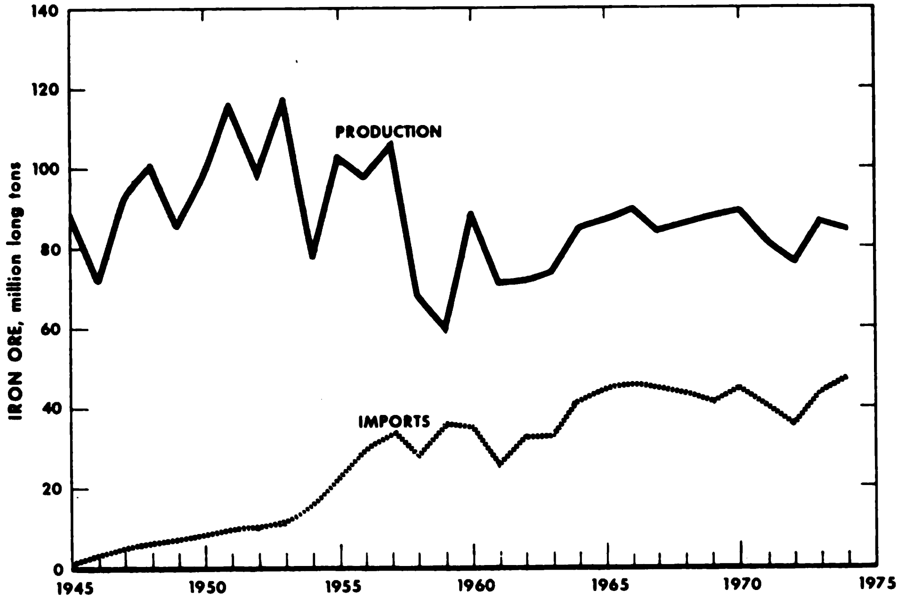

Figure 1.—United States iron ore production and imports for consumption.

EMPLOYMENT

Statistics on employment and productivity in the iron ore industry in 1973 and 1974 are shown in table 2. There was a slight decline in productivity in 1974, following a rise of about 8% in 1973. The decline was probably due in part to increasing employment at new mines and plants that did not begin production until relatively late in the year.

Employment data for 1973 and 1974

were collected by the Mining Enforcement and Safety Administration (MESA). As the number of shifts and average number of days worked were not reported, these data are not shown in table 2 as they were for 1972 and earlier years. The total number of hours worked were reported, however, so that continuity of data on hourly productivity was maintained.

Owing to changes in methods of reporting instituted by MESA or by some mining companies, the number of employees reported at some mining operations was considerably larger in 1973–74 than in 1972, but the total number of hours worked was not proportionately changed. Comparison of the average number of hours worked, per employee, for each year indicated abnormally high figures for 1972. Consequently, the total number of employees reported in industry for that year (14,000)[4] was probably at least 2,000 too low.

DOMESTIC PRODUCTION

U.S. mine production and shipments of iron ore in 1974 declined by 4% and 6%, respectively. Shipments of ore from U.S. ports on the Great Lakes totaled 68.8 million tons, about 7% less than 1973. Although the declines were mainly caused by lower demand, they were partly due to strikes at some mines during August and a 2-month strike by Canadian merchant marine officers which severely reduced shipments between the United States and Canada. The mine strikes occurred during the first 15 days of August, affecting a total of five companies and 10,000 employees in the Lake Superior district and reducing ore output by about 1.3 million tons. Domestic consumption of iron ore declined about 6%, and despite record imports the available supply at yearend was less than that 1 year earlier and was the lowest since 1956.

Mine output of usable ore consisted 72% of agglomerates, 22% of natural ore concentrates, and 6% of direct-shipping ore. Pellets made up 71% of total production. Increased output of direct-shipping ore in 1974 was largely due to production from the Stephens mine in Minnesota, which was inactive in 1973. The total number of active mines (66) was the same as in 1973 and included 60 open pits and 6 underground mines.

Crude ore production in 1974 was 217.2 million tons, only about 1% less than in 1973. Open-pit mines produced 96% of the total, and nearly 98% of the crude ore was shipped to beneficiation plants. The average iron content of all crude ore mined in 1974 was 33.7%, and the average for all usable ore produced was 60.6%. Nationwide, the ratio of crude ore mined to usable ore produced was 2.57:1, compared with 2.50:1 in 1972 and 1973.

The Lake Superior district accounted for about 84% of U.S. output of iron ore in 1974. Of the total production of usable ore, Minnesota produced 69% and Michigan 13%; the remaining 18% was produced in 19 other States.

In Minnesota, plans for four major taconite projects were announced during 1974, while construction of a fifth facility was continued. The five projects will increase annual production capacity for iron ore pellets on the Mesabi range by 21 million tons by 1978. Eveleth Taconite Co. will expand production capacity by 3.6 million tons (to a total of 6 million tons), Hanna Mining Co. will expand capacity of the National Steel Pellet Project by 3 million tons (to a total of 5.8 million tons), and United States Steel Corp. will expand capacity at Minntac by 6 million tons (to a total of 18.5 million tons). North of Virginia, Inland Steel Co. began construction of the Minorca facility, which will have a production capacity of 2.6 million tons of pellets per year. North of the Hull-Rust-Mahoning open pit, Hibbing Taconite Co. continued construction of its mine and plant which will have an initial production capacity of 5.4 million tons. The latter facility was scheduled to begin production in 1976, while the other four projects are slated for completion in 1977. Total investment in these projects was approximately $800 million. During 1974, production of iron ore pellets from the six taconite operations on the Mesabi range totaled 40.9 million tons.

The Whitney and Rana natural ore mines began production in 1974. The Whitney mine was operated by Hanna Mining Co. and the Rana mine by Rhude & Fryberger, Inc. The end product of both operations was natural ore concentrates. The

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[4] Minerals Yearbook, V. I, 1972, p. 631.

Whitney ore was being processed at the Pierce concentrator, since the Pierce mine was closed by Hanna in early 1974. On the eastern Mesabi, United States Steel Corp. was preparing the Donora natural ore mine for production in 1975. The Donora mine is adjacent to the Stephens mine, from which United States Steel produced direct-shipping ore and concentrates in 1974. The Stephens mine was inactive in 1973. Ore reserves at the Donora property totaled about 10 million tons.

In the U.S. District Court in Minneapolis and St. Paul, trial of the suit brought against Reserve Mining Co. by the U.S. Department of Justice was concluded in 1974. The suit originally alleged that taconite tailings discharged by the company's concentrator at Silver Bay were polluting Lake Superior. Later, the Government also contended that fibrous particulate matter discharged into water and air constituted a public health hazard. The District Court ruled that there was a health hazard and ordered the plant closed on April 20. The plant resumed operations on April 22, after the U.S. Court of Appeals ruled that there was not enough evidence to support the District Court's decision. Later in the year, the company submitted a plan to State authorities by which it proposed to shift discharge of tailings to a basin on land, improve air quality controls, and modify its production process at a total cost of $242 million. By yearend, the plan had not been approved by the State agencies concerned.

In Michigan, the Tilden project south of Ishpeming was completed in 1974. The concentrator began production in October and the first shipment of pellets was made in December. The facility has a production capacity of 4 million tons of pellets per year and was built at a cost of $200 million. The concentrator is the first plant in the United States to beneficiate fine-grained, hematitic crude ore of the taconite type by cationic flotation of silica. The concentrating process is based on a method of flocculation and desliming patented by the Bureau of Mines. Another significant development was the expansion of production capacity at the Empire magnetic taconite facility by about 50%, to 5.2 million tons of pellets per year. Total production capacity for pellets in Michigan by yearend was 16.3 million tons per year. Production of pellets in 1974 was 10.7 million tons.

In Missouri, Pilot Knob Pellet Co., a subsidiary of the Hanna Mining Co., modified its plant to produce self-fluxing pellets. New installations included a flotation circuit to remove additional alkali and silica from the concentrate, and another secondary grinding mill. Production capacity was increased by 15% to 1.15 million tons of pellets per year. The crude ore feed for the plant is mined by underground methods and contains about 42% iron in the form of magnetite. Pellet shipments from Pilot Knob in 1974 totaled 683,000 tons.[5]

In Pennsylvania, Bethlehem Steel Corp. announced that the iron ore concentrator and pelletizing plant at Cornwall would be reactivated in early 1975. Ore for the plants will not be mined at Cornwall but will be purchased from other mines in the United States and abroad. The pellets will be shipped to the company's blast furnaces at Bethlehem and Johnstown, Pa. Production capacity for pellets will be about 750,000 tons per year.

CONSUMPTION

Consumption of iron ore and agglomerates in 1974 was about 6% less than in 1973. Consumption in steelmaking furnaces declined about 21%, while consumption in blast furnaces was down 5.8%. The decline in consumption for steelmaking appeared to be mainly related to the decline in output of open hearth steel and increased use of scrap for that purpose in 1974. Of the total consumption, blast furnaces accounted for 98.3%, steel furnaces accounted for 1.2%, and the remaining 0.5% was used in the manufacture of cement, heavy-media materials, and other miscellaneous products. In blast furnaces, the weight ratio of iron ore and agglomerates consumed to pig iron produced was 1.57:1 in 1974, compared with 1.56:1[6] in 1973.

Iron ore pellets made up 52% of all iron ore and agglomerates consumed, and 65.6% of all agglomerates consumed in

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[5] Skillings' Mining Review. V. 64, No. 14, Apr. 5, 1975, p. 16.

[6] Revised figure.

1974. These proportions were almost identical to those of 1973.

Consumption data are shown in tables 11 and 12. In these tables, iron ore concentrate used to produce pellets and other agglomerates at mine sites is not reported as iron ore consumed; its consumption was reported only when such agglomerate was shipped to the furnace site and used (table 11). Iron ore concentrates and fines used to produce agglomerates (such as sinter) at iron and steelmaking plants is reported as iron ore consumed (table 12), and consumption of agglomerates from this source is included in table 11. In table 12 the difference in weight between iron ore consumed and agglomerate produced results from the addition of materials such as flue dust, mill scale, lime, and coke.

STOCKS

Stocks of iron ore and agglomerates at U.S. mines, docks, and consuming plants totaled 57.9 million tons on December 31, 1974. This was 3.3% less than a year earlier and the lowest since 1956. During 1974, stocks of ore at consuming plants were reduced to as little as 24 million tons, possibly a record low, and stock of ore at the mines at yearend totaled 9.4 million tons, the lowest since 1960. Of the 48.5 million tons on hand at U.S. docks and furnace yards at yearend, 62% consisted of U.S. ores, 15% of Canadian ores, and 23% of other foreign ores.

PRICES

Published prices for Lake Superior iron ores increased four times during 1974. The first increase was announced early in May, following increases in freight rates in March and April and the termination of price controls at the end of April. Subsequent increases came in June, following another rise in freight rates; in August, after negotiation of new labor contracts; and in late December. By yearend, published prices were 32% to 51% higher than at the beginning of the year. However, because the increases occurred at intervals of 1 to 4 months, and because the increase in December affected very little ore shipped during 1974, the average increase in price ranged from 17% to 20% for different grades.

The price changes and month of announcement are shown in the following tabulation:

1974 Month	Mesabi non-Bessemer (per long ton)	Mesabi Bessemer (per long ton)	Old Range non-Bessemer (per long ton)	Old Range Bessemer (per long ton)	Pellets (cents per long ton unit)
January	$11.91	$12.06	$12.16	$12.31	29.4–30.019
May	13.85	14.00	14.10	14.25	35.5
June	14.60	14.75	14.85	15.00	36.3
August	15.75	(1)	(1)	(1)	40.619
December [2]	17.28	(1)	(1)	(1)	44.559

[1] Not available at the times shown.

[2] Prices in effect for one company on Dec. 23. The pellet price was in effect for two companies on Dec. 30.

The increases were not the same for all companies, but the prices shown indicate the minimum and maximum values during 1974 for Mesabi non-bessemer ore and for iron ore pellets, the two principal grades of ore shipped from mines in the Lake Superior district. Except for pellets, the values represent the price per gross ton of ore, basis 51.5% Fe natural, delivered rail-of-vessel at lower lake ports. The price of pellets is shown in cents per long ton unit of contained iron, at the same delivery point. In all cases, any increase in transportation and handling costs, subsequent to the announcement date of the price shown, was to be borne by the buyer.

The average value (f.o.b. mine or concentrating plant) of usable iron ore shipped from domestic mines in 1974 was $16.34 per long ton, compared with $12.84

in 1973 and $12.20 in 1972. These values were calculated from producers' statements and approximated the commercial selling price less the cost of mine-to-market transportation.

Significant increases in price were also evident for many foreign iron ores in 1974. Contract prices for delivery of Swedish ores in 1974 were reported by the two major producers to be about 25% higher than in 1973. Prices for Liberian ores produced by the Lamco Joint Venture in 1974 averaged about 35% higher than in the previous year. The average f.o.b. value of Venezuelan iron ore exported to the United States, as indicated by data released by the Bureau of the Census, rose from $10.03 per long ton in January 1974 to $14.65 in December, an increase of 46%. The nominal price quoted in American Metal Market[7] for Brazilian iron ore (68% to 69% Fe, f.o.b. Atlantic shipping port) in mid-1974 was $15.00 per long ton, up 25% since late 1973. Elsewhere, price increases ranging between 15% and 30% were negotiated between Japanese buyers and various Australian, Canadian, Indian, and South American producers during 1974. Indications were also that ore prices would continue to rise in 1975.

TRANSPORTATION

The 1974 iron ore shipping season on the Great Lakes began at Escanaba, Mich., on April 1, and by April 18 ore shipments had started from the other six U.S. ports on the lakes. The resumption of shipping was only about 2 months after the last shipment of the 1973 season, which ended at Two Harbors, Minn., on February 5, 1974. Iron ore shipments during 1974 from U.S. lake ports totaled 68.8 million tons, about 7% less than in 1973; this total included 1.47 million tons shipped during the extended 1973 season through January and February 1974. An additional 18.8 million tons of ore was shipped during 1974 to destinations on the Great Lakes from Canadian ports, including Port Cartier, Pointe Noire, and Sept-Iles on the St. Lawrence River. Of the total lake shipments of 87.6 million tons, 75% consisted of iron ore pellets.

As in the past few years, the ore shipping season was extended past normal closing dates and shipments continued from six U.S. ports into 1975. The Welland Canal also stayed open about 1 month later than usual, until January 17, 1975. The latter extension was partly due to a backlog of ore and coal shipments to Canadian ports which resulted from a strike by Canadian mates and engineers lasting from August 8 to October 4, 1974.

Statistics on lake shipments of iron ore, by port, during the 1974 season (including shipments in early 1975) are shown in the following tabulation:

Lake shipping port	Number of vessels loaded[1]	Total tonnage shipped[2] (thousand long tons)	Average cargo (long tons)	Largest cargo (long tons)
Duluth, Minn	1,124	17,887	15,914	31,135
Taconite Harbor, Minn	423	11,014	26,038	58,274
Silver Bay, Minn	583	10,519	18,043	27,756
Two Harbors, Minn	444	10,379	23,376	54,169
Superior, Wis	528	10,150	19,223	30,837
Escanaba, Mich	549	9,106	16,586	32,620
Marquette, Mich	169	3,026	17,905	25,519
Total	3,830	72,081	XX	XX

XX Not applicable.
[1] Includes shipments during season extension into early 1975.
[2] Rounded to nearest 1,000 tons.

Sources: Skillings' Mining Review, various issues (1975); and Annual Report of Lake Carriers Association, 1974, p. 42.

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[7] American Metal Market. V. 81, No. 154, Aug. 8, 1974, p. 6.

The following statistics on iron ore receipts at lower lake ports are for 1973; 1974 data were not available.

Port	Thousand long tons[1]
Cleveland, Ohio	16,143
Detroit, Mich	9,879
Indiana Harbor, Ind	9,068
South Chicago, Ill	7,671
Gary, Ind	7,193
Buffalo, NY	6,865
Conneaut, Ohio	6,776
Toledo, Ohio	5,783
Lorain, Ohio	5,024
Ashtabula, Ohio	4,693
Burns Harbor, Ind	3,997
Huron, Mich	2,585
Total	85,677

[1] Rounded to nearest thousand tons.

Source: Lake Carriers Association Annual Report 1974, p. 41, quoting U.S. Army Corps of Engineers, Waterborne Commerce of the United States, 1973, Part III.

The trend toward increasing size of lake ore carriers and automation of unloading systems continued. Three more 1,000-foot vessels of up to 59,000 tons cargo capacity were ordered during 1974, two by Bethlehem Steel Corp. and one by National Steel Corp. The Bethlehem vessels will be built by Bay Shipbuilding Corp. at Sturgeon Bay, Wis., and are scheduled to begin service in 1977 and 1979. The National Steel vessel will be built by American Ship Building Co. at Lorain, Ohio, and is scheduled to begin service in 1978. Construction of two similar vessels was begun by the latter company in 1974 for Pickands Mather & Co. Meanwhile, the 1,000-foot tug-barge unit *Presque Isle* completed its first year of service, carrying 37 cargoes averaging about 55,000 tons each of iron ore pellets from Two Harbors, Minn., to lower lake ports during the 1974 season. Two new ore carriers, of about 34,000- and 20,000-ton cargo capacity, began service in 1974; three vessels were converted to self-unloaders; and two vessels were lengthened by 120 feet each to increase cargo capacity. Lengthening of three more vessels and conversion of two others to self-unloaders was planned by 1976.

Litton Industries Inc. announced in mid-1974 that it was terminating operations and planning to sell its shipyard at Erie, Pa. The yard built the 1,000-foot carriers *Stewart J. Cort* and *Presque Isle.*

In ocean shipment of iron ore, individual cargoes of more than 220,000 tons were loaded for the first time at the Brazilian ports of Tubarão and Sepetiba during 1974. The largest cargo was 259,000 tons, loaded at Tubarão. These very large shipments were destined for Japan, where port facilities at the Oita iron and steelworks could accommodate vessels of up to 300,000 tons deadweight and four other works (Kimitsu, Tobata, Fukuyama, and Chiba) were reportedly capable of handling vessels of 200,000 deadweight tons or more. The largest cargo received in Europe in 1974 appeared to be about 156,000 tons, at Europoort, although reported capacities were 200,000 deadweight tons at Europoort and 250,000 deadweight tons at the Taranto steelworks in Italy. In Scotland, the British Steel Corp. began construction of a new iron ore receiving terminal at Hunterston on the Firth of Clyde; the facility was planned to accommodate vessels of up to 250,000 deadweight tons. In the United States, relatively shallow channel depths continued to limit incoming cargoes to about 65,000 tons.

Ocean freight rates for iron ore declined sharply during 1974. The decline appeared to be caused mainly by increased availability of combination (ore-oil or ore-bulk-oil) carriers, arising from a decline in petroleum trade. Spot fixtures reported by Metal Bulletin during 1974 indicated that many rates were 25% to 60% lower in December than in January. Some rates published during the fall of 1974 included the following (tonnage of cargo shown in parentheses): From Tubarão, Brazil, to Dunkirk and other West Europe, $4.10 to $6.25 per ton (72,000 to 80,000), and to Japan, $4.75 to $5.00 (125,000 to 135,000); from Sept-Iles, Canada, to U.S. east coast, $3.00 (35,000), to the Netherlands, $3.25 (70,000), and Immingham, England, $4.25 (78,000); from western Australia to West Europe, $5.80 to $7.50 (100,000 to 150,000), and to U.S. east coast, $8.20 (65,000); from Monrovia, Liberia, to West Europe, $3.55 to $5.50 (40,000 to 80,000); from Narvik to Teesside, United Kingdom (Redcar), $2.75 (75,000); from Peru to U.S. east coast, $8.50 (26,000); from Madras (India) to Dunkirk, $18.60 (38,000); and from Chile to Japan, $7.50 (100,000). The following tabulation shows various ore movements:

Ocean shipping port	Number of vessels loaded	Total tonnage shipped (thousand long tons)	Average cargo (long tons [1])	Largest cargo (long tons [1])
Tubarão, Brazil [2]	724	52,047	72,000	259,000
Port Hedland, Australia	NA	38,835	NA	NA
Dampier, Australia	449	32,245	NA	NA
Narvik, Norway [3]	[e] 509	22,145	44,000	[e] 105,000
Puerto Ordaz, Venezuela	559	21,718	39,000	[e] 42,000
Sept-Iles, Canada	[4] 560	20,468	37,000	153,000
Buchanan, Liberia	NA	12,774	NA	NA
Mormugao, India	NA	12,622	NA	NA
Monrovia, Liberia	[e] 260	12,278	[e] 47,000	NA
Nouadhibou, Mauritania	236	11,482	49,000	NA
Cape Lambert, Australia	122	10,887	89,000	119,000
San Nicolás, Peru [2]	129	9,941	77,000	NA
Port Cartier, Canada	208	8,450	41,000	NA
Lulea, Sweden	427	8,070	19,000	NA
Sepetiba, Brazil [2]	78	5,823	80,000	253,000
Pointe Noire, Canada	237	5,445	23,000	NA
Porto Salazar, Angola	73	5,215	71,000	144,000
Guayacan, Chile	50	3,731	75,000	106,000
Guacolda, Chile	47	3,045	65,000	92,000

[e] Estimate. NA Not available.

[1] Rounded to nearest 1,000 tons.

[2] Exports only.

[3] Exports of Swedish ore.

[4] Including 303 tons destined for Great Lakes ports.

Principal source: Skillings' Mining Review, various issues, 1975.

Lake freight rates for iron ore were increased twice during 1974. The first increase was announced prior to the start of the 1974 shipping season, and the second was announced late in June. Rising fuel costs were cited as a major factor in both actions. There were no further increases by yearend; however, rates during the last half of the year were 25% to 34% higher than in December 1973. Rates in effect from late June through December 1974 were as follows, per gross ton: From the head of the lakes to lower lake ports, $3.30; from Marquette, Mich., to lower lake ports, $2.75; from Escanaba, Mich., to Detroit and Lake Erie, $2.48; and from Escanaba to lower Lake Michigan ports, $1.98. The additional charge for iron ore cargoes requiring more than 24 hours to unload, and for delivery to docks not capable of handling vessels of more than 23 feet draft, was increased to 25 cents per ton, from 10 cents in 1973. Handling charges (car to vessel at upper lake ports, and rail of vessel to car or stockpile at lower lake ports) ranged from 34 to 95 cent per ton and were about 24% higher than in 1973.

Railway freight rates during the last half of 1974 were mostly about 25% higher than in December 1973, although the increased cost for some hauls ranged between 8% and 37%. Rates published in December 1974[8] included the following:

	Per gross ton
Cuyuna and Mesabi Ranges to Duluth-Superior	$2.41
Menominee Range to Escanaba	2.24
Pellets from Empire mine to Presque Isle (Marquette)	1.10
Pellets from Nashwauk and Keewatin (Minn.) to Duluth-Superior, delivered direct into vessel	1.85
Pellets from Marquette Range to Escanaba, delivered into vessel	1.30
Mesabi Range to Chicago district	8.73
Mesabi Range to Pittsburgh and Wheeling districts	17.17
Black River Falls (Wis.) to Chicago	3.56
Lake Erie ports to Pittsburgh and Wheeling districts	4.51–4.62
Benson Mines (N.Y.) to Cleveland	8.11
Baltimore to Pittsburgh district	6.62
Pilot Knob, Mo., to Granite City, Ill.	3.43
Cedar City, Utah, to Minnequa, Colo.	11.25
Cima, Calif., to Los Angeles harbor	5.11

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[8] Skillings' Mining Review. V. 63, No. 52, Dec. 28, 1974, p. 22.

FOREIGN TRADE

U.S. exports of iron ore in 1974 declined 15% in tonnage. The decline was mainly due to reduced deliveries to Canada, which resulted from a strike of Canadian merchant marine officers. The strike lasted from August 8 to October 4. Exports to Canada were 20% less than in 1973, and shipments to Japan were 4% less.

U.S. imports of iron ore for consumption reached an alltime high of 48 million tons in 1974. The total was 4% higher than the previous record of 46 million tons in 1966. Compared with 1973, imports from Canada declined by nearly 2 million tons, but this was more than made up by increased imports from Venezuela. Imports from Brazil increased by more than 100% to 6.6 million tons, and increases were evident from Angola, Australia, Chile, and Sweden. A total of 126,000 tons was also received from the Soviet Union. The Philadelphia and Baltimore customs districts continued to receive the bulk of incoming shipments, followed by Mobile, Cleveland, Buffalo, and Chicago, in that order.

The average value of imported iron ore, f.o.b. country of origin, was $14.50 per ton in 1974, compared with $12.32 in 1973. The average value of exported ore was $15.13 per ton, 10% higher than in 1973.

WORLD REVIEW

Australia.—With production of 95 million tons and exports of more than 80 million tons in 1974, Australia remained the world's second largest producer and leading exporter of iron ore. Company shipments in 1973 and 1974, in thousand long tons, were reported as follows:

Producer	1973	1974
Hamersley Iron Pty. Ltd	27,151	32,245
Mt. Newman Mining Co. Pty. Ltd	26,316	30,904
Goldsworthy Mining Ltd	8,469	7,931
Broken Hill Pty. Co. Ltd	11,928	10,925
Cliffs Robe River Iron Associates	8,333	10,887
Savage River Mines	2,334	2,340
Frances Creek Iron Mining Corp	800	486
Western Mining Corp. Ltd	835	578
Total	86,166	96,291

Source: Skillings' Mining Review, various issues, 1974 and 1975.

Prices for Australian iron ore under Japanese contracts were raised in September 1974 by 16% to 27%. Prices for most ore products appeared to be raised by $2.25 to $2.50 per ton.

In 1974, the Mt. Newman Co. increased production capacity for iron ore to 35 million tons annually. A further expansion of capacity to 40 million tons was underway by yearend.

Total shipments of iron ore pellets in 1974 were estimated at 9.5 million tons. Production of pellets by the Hamersley Co. was 1.6 million tons in 1974, 25% less than in 1973. The company was modifying its plant to increase production capacity to 3 million tons annually. Capacity of the Robe River pellet plant, from which 3.9 million tons was shipped in 1974, was being increased to 5 million tons per year.

Goldsworthy Mining Ltd. was planning to mine iron ore deposits in "Mining Area C," located in the Pilbara region about midway between Mount Whaleback and Mount Tom Price, by 1980. The deposits were reported to contain proved reserves of 750 million tons of ore averaging 62.5% iron and 0.06% phosphorus. Plans were to export 10 million tons of pellets and lump ore per year. Development projects would include a 264-mile railway and construction of a new loading pier at Port Hedland to accommodate 163,000 deadweight ton vessels. Cost of the project was estimated at about $500 million.

In July 1974 Western Mining Corp. Ltd. (WMC) completed contracted shipments of iron ore to Japan from the Koolanooka deposit, 132 miles southeast of Geraldton in western Australia. Operations were stopped because no additional contracts were negotiated. A joint venture owned 50% by WMC and 25% each by the Hanna Mining Co. and Homestake Mining Co., the mine had shipped 5.1 million tons of ore since early 1966.

Brazil.—Production and exports of iron ore continued to increase at a rapid rate. Exports in 1974 totaled about 58 million tons, 35% more than in 1973, and were valued at approximately $570 million. The principal destinations were the ECSC (23.4 million tons), Japan (19.1 million tons), and the United States (6 million tons).[9] Brazilian exports of iron ore in 1975 were expected to approach 70 million tons.

Production and exports of iron ore in 1974 by the major producers were as follows: Companhia Vale do Rio Doce (CVRD), 55 million tons of which 82% was exported; Minerações Brasileiras Reunidas, S.A. (MBR), 8.3 million tons of which 83% was exported; S.A. Mineração da Trindade, S.A. (SAMITRI) and Ferteco Mineração, S.A. (combined output), about 8 million tons of which 6.5 million tons were exported. Domestic shipments by all Brazilian producers totaled about 11 million tons.

Shipments of iron ore pellets in 1974 totaled 4.13 million tons, of which 79% was exported. All of the pellets were produced by CVRD in two plants at Tubarão. Under agreements announced in 1974 between CVRD and Italian, Japanese, Spanish, Egyptian, and West German companies, six more pelletizing plants with a total output capacity of 20 million tons will be built at Tubarão during the next 4 years. CVRD will have a 51% interest in most of these ventures. The first of these plants will come onstream in 1976, and three more will be completed in 1977. Under the agreement with the Egyptian company, 3.6 million tons of pellets are to be shipped annually to Egypt for reduction in a sponge iron plant to be built in Alexandria. CVRD will invest $4 million in the latter facility.

Amazonia Mineração S.A. (AMSA) continued engineering studies for exploitation of the Serra dos Carajas iron ore deposits in the State of Pará. Very large investments will be required (estimated at more than $2 billion) for mine development, construction of a 650-mile railroad, and port facilities near Itaqui, but the Government hoped that production of 12 million tons of ore annually could begin by 1980, reaching 50 million tons by 1985. Japanese, British, and Spanish companies were possible participants in the project. The mining concession was received by AMSA in 1974. AMSA was owned 51% by CVRD and 49% by United States Steel Corp.

Canada.—Exports of iron ore in 1974 totaled 36.7 million tons, of which about 55% was shipped to the United States, 30% to nations of the ECSC, and 12% to Japan. Imports were about 1 million tons less than in 1973, mainly because of a shipping strike on the Great Lakes. Consumption of iron ore in Canada was estimated at 13.4 million tons, compared with 13.5 million tons in 1973.[10]

The Quebec-Labrador region continued to account for the bulk of iron ore production, with 74% of the total in 1974, followed by Ontario (23%) and British Columbia (3%). The largest producers were Iron Ore Co. of Canada (IOC) with shipments of 20.3 million tons; Quebec Cartier Mining Co. (QCM), 8.3 million tons; and Wabush Mines, 5.75 million tons. Production by IOC was considerably less than expected, due to technical problems and high labor turnover. The company's output at Labrador City was 11.9 million tons, about half of expected capacity, while output from the new pelletizing plant at Sept-Iles was 1.9 million tons, about one-third of production capacity. The performance at both operations was much improved by yearend, and production in 1975 was expected to be substantially increased. Total output capacity of IOC was 33 million tons of iron ore products per year.

QCM continued to develop its properties at Mount Wright and Fire Lake for production in 1975. The 88-mile extension of the company's railroad, from Gagnon to Mount Wright, was completed in 1974, and construction of facilities at Mount Wright was reportedly 80% completed by yearend. Annual production capacity for concentrate will be 16 million tons at Mount Wright, and initially 1.2 million tons from the Fire Lake deposits, increasing to 5 million tons by 1977. In 1974 Sidbec-Dosco, Ltd., the Quebec-government-owned producer of iron and steel, announced that it will acquire 50% of the annual production from Fire Lake and has an option to acquire an additional 1.5 million tons per year. The company wants to build a pelletizing plant at Port Cartier, with an annual output capacity of 6 million tons. If the project is approved by the government, Sidbec-Dosco will provide $160 million for construction of the plant. Total cost of the project was estimated at $250 million. Sidbec-Dosco operated a 400,000-ton-per-year direct reduction plant at Contrecoeur in 1974 and ordered a second plant, with output capacity of 600,000 tons, for completion in 1976. Both plants employ the Midrex reduction process.

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[9] According to 1974 import statistics published by the recipient countries.

[10] Goodman, R. J. Can. Min. J., v. 68, No. 754, February 1975, pp. 96–108.

At the Griffith mine in Ontario, the Steel Co. of Canada, Ltd. was building a direct-reduction plant of the Stelco-Lurgi/Republic-National (SL/RN) type. The plant will have a production capacity of about 400,000 tons of sponge iron per year and was scheduled for completion in 1975.

Steep Rock Iron Mines, Ltd. continued feasibility studies of its proposed iron ore concentrating, pelletizing, and direct-reduction project at Lake St. Joseph, Ontario. The project was estimated to cost about $500 million. Output capacity would be 4 million tons of pellets per year, half of which would be reduced to sponge iron.

Finland.—Rautaruukki Oy. continued to develop the Rautavaara underground iron ore mine in 1974. Production of iron concentrates was expected to begin in 1975 at the rate of 500,000 tons per year. The company also announced that the Mustavaara mine, now being developed for production in 1976, will supply 200,000 tons per year of pelletized iron concentrate. Output from both mines will be used at the company's blast furnaces near Raahe.

Finland's imports of iron ore in 1974 totaled 1.1 million tons.

Gabon, Guinea, and Ivory Coast.—In Gabon, the Government acquired 60% of Société des Mines de Fer de Mekambo (SOMIFER) in July 1974 for an undisclosed sum. The action was reportedly taken in the hope of speeding up development of the Belinga iron ore deposits. Bethlehem Steel Corp., one of the owners of SOMIFER, will conduct further field work and laboratory tests on the Belinga deposits during the next 2 years.

In Guinea, a technical and economic study of the Nimba iron ore deposits was undertaken in 1974 by the Swedish firm of Luossavaara-Kiirunavaara AB (LKAB). The study was directed toward an output of 15 million tons per year. The work was commissioned by Société des Mines de Fer de Guinée (Mifergui), which is 50% owned by the Government.

In Ivory Coast, a group of U.S., Japanese, and West European companies together with an Ivory Coast public corporation was studying the feasibility of exploiting the Mount Klahoyo iron deposits, near Man, by 1980. Annual production of 9 to 12 million tons of iron ore pellets was being considered, at a projected minimum cost of $450 million.

India.—Production and exports of iron ore in 1974 declined about 2% and 5%, respectively, compared with those in 1973. Exports were estimated at 20.4 million tons in 1974, with more than 80% destined for Japan.

Chowgule & Co. Ltd. planned to build a second iron ore pelletizing plant near Mormugao port in Goa. The new plant will have a production capacity of about 1.8 million tons per year and may be completed by 1977. The company produced about 450,000 tons of pellets in 1974 for export. Chowgule also contracted with a U.S. steel company in 1974 to supply 1 million tons of iron ore over a 4-year period.

The Government-owned Gujarat Industrial Investment Corporation Ltd. was reported to be planning construction of a direct-reduction plant for iron ore. The plant would have a production capacity of about 180,000 tons of sponge iron per year, would be fueled by natural gas from the Ramol oilfield in Gujarat, and would use iron ore produced in Goa or at the Hospet-Donamalai mines in Karnataka.

The proposed arrangement by which Iran would finance development of the Kudremukh iron ore deposits in return for exports of the ore to Iran apparently had not been formally concluded by the end of 1974.

Indonesia.—Iron ore production continued to be limited to concentration of beach sand deposits of titaniferous magnetite near Cilacap in central Java, by P. N. Aneka Tambang, a Government-owned company. Exports of concentrate in 1974 totaled about 370,000 tons, all of which was destined for Japan. The contract with the Japanese calls for export of 300,000 tons annually through fiscal 1980.

In west Java, Swindell-Dressler Co. of Pittsburgh, Pa., was building a direct-reduction plant for P. T. Krakatau-Ferrosteel. The facility will have a production capacity of 2 million tons of iron per year and will employ the reduction process developed by Hojalata y Lámina, S.A. (HYLSA) of Mexico. Completion of the project was planned by 1978.

A group of Japanese companies, assisted by the Indonesian Government, continued to study the feasibility of establishing an iron ore stockpiling and sintering center in southeastern Sumatra. Construction of facilities would start around 1980, and would include establishment of production capacity for 6 million tons of sinter per year. Later, this capacity would be doubled. Since most vessels carrying iron ore to Japan pass through this area, unloading in Sumatra instead of Japan would permit many vessels to pick up return cargoes such as petroleum without spending so much voyage time in ballast. It would also help to ease problems of land acquisition, labor costs, and pollution control at steel plants in Japan, and would provide larger stockpiles of ore than are now available to Japanese consumers.

Iran.—Iron ore continued to be produced at Bafq, near Yazd, for consumption at the iron and steelworks near Isfahan. Larger deposits at Gol-e-Gohar, south of Kerman, were being evaluated in 1974 by the Swedish firm of Gränges AB. Reserves of iron ore at Gol-e-Gohar were tentatively estimated by an Iranian source at 400 million tons. Proven reserves at Bafq were reported to be about 150 million tons. Exploitation of the Gol-e-Gohar deposits may require extension of the railroad from Zarand south to Kerman and Bandar Abbas, a project estimated to require 3 to 4 years for completion. The Iranian Government plans to make Bandar Abbas an important iron and steel center, using abundant supplies of natural gas to produce sponge iron from domestic and/or imported iron ore. In 1974 Swindell Dressler Co. of Pittsburgh, Pa., contracted with the National Iranian Steel Industries Co. (NISIC) for construction of a direct-reduction plant having a production capacity of 1 million tons of sponge iron per year. The plant was originally slated for construction at Isfahan but instead may be located at Bandar Abbas. The plant will employ the Hojalata y Lámina (HYL) reduction process and was scheduled for completion by 1977.

NISIC contracted with the West German firm of Thyssen A.G. in 1974 for construction of a reduction plant at Ahvaz. This plant will employ the Purofer reduction process and will have a production capacity of about 300,000 tons of sponge iron per year. Under a previous contract with Korf Industri und Handel G.m.b.H., a reduction plant using the Midrex process will also be built at Ahvaz. The latter facility will have a production capacity of 1.2 million tons of sponge iron per year; the first unit was scheduled to begin production in 1975. Another development in 1974 was a contract between NISIC and Lurgi Chemie und Huttentechnik of West Germany for construction of an iron ore pelletizing plant at Ahvaz. This plant will have a production capacity of 5 million tons of pellets per year and was scheduled for completion by 1978.

Iron ore for the Ahvaz plants was expected to be imported through the port of Bandar Shahpur at the northwest end of the Persian Gulf. Port facilities were being improved in 1974.

A proposed arrangement between the Iranian and Indian Governments, under which Iran would finance development of the Kudremukh iron deposits near the west coast of India in return for exports of iron ore to Iran, was apparently not yet concluded by yearend.

Japan.—Imports of iron ore in 1974 totaled 139.6 million tons valued at approximately $2 billion. Australia continued to be the major supplier with about 48% of the total, followed by Brazil (14%) and India (12%).

Production of iron ore agglomerates from imported and domestic ores totaled 115.1 million tons in 1974, including 108.6 million tons of sinter and 6.5 million tons of pellets. An additional 11.3 million tons of pellets was imported.

Consumption of iron-bearing materials by the Japanese iron and steel industry in 1974 included 115 million tons of conventional iron ore, 9.6 million tons of imported pellets, 4 million tons of titaniferous magnetite concentrates ("iron sands"), 1.5 million tons of ferruginous manganese ore, 100,000 tons of pyrite cinder, and 13.2 million tons of unspecified iron-bearing materials, probably furnace dust, slag, mill scale, etc.

Liberia.—Production and exports of iron ore increased slightly in 1974. Exports totaled 25.1 million tons, of which 18.2 million tons were destined for countries of the ECSC. Shipments of pellets by Bong Mining Co. and the Lamco Joint Venture totaled 4.2 million tons. Total ore shipments by producer, in million tons were: Lamco Joint Venture, 12.8; Bong, 6.7; National Iron Ore Co., 3.5; and Liberia Mining Co., 2.1.

Mauritania.—On November 28, 1974, the Mauritanian Government nationalized iron ore operations of S.A. des Mines de Fer de Mauritanie (MIFERMA). MIFERMA was principally owned by French interests, but British and Italian ownership was also significant; minor shares were also held by West German and U.S. groups, as well as by the Mauritanian Government. The state-owned company now controlling iron ore operations is Société Nationale Industrielle et Minière (SNIM). Iron ore exports, which totaled 11.5 million tons in 1974, account for about 40% of the country's gross national product and 60% of foreign exchange earnings.

Norway.—A/S Sydvaranger brought its second grate-kiln pelletizing plant into production at Kirkenes in May 1974. Production capacity for pellets was thus raised to 2.7 million tons per year. The company was also planning to build a direct-reduction plant for pellets on the island of Karmøy. Fuel for the plant would be natural gas from the Norwegian sector of the North Sea. The company applied to the Ministry of Industry for annual supplies of 12.4 billion cubic feet from the Frigg gasfield.

A/S Rana Gruber was preparing the Ortfjell ore body for production in 1976. This ore body contains about 150 million tons of ore averaging 32% iron, and will be the company's main source of ore by 1980.

Exports of iron ore from Norway in 1974 totaled 2.6 million tons.

South Africa, Republic of.—Production and exports of iron ore declined about 1% and 22%, respectively, compared with those of 1973. Exports totaled 2.65 million tons. Domestic consumption dropped slightly to 6.5 million tons. The South African Iron and Steel Industrial Corp. (ISCOR) continued to account for more than half of the country's output. The company shipped 3.8 million tons of ore from the Sishen mine and produced 2.1 million tons from the Thabazimbi mine during the year ended June 30, 1974. Palabora Mining Co. Ltd. produced 2.2 million tons of magnetite concentrate in 1974, down 28% from output in 1973.

ISCOR continued construction of mine, railway, and port facilities for the Sishen-Saldanha Bay project in 1974. Minable reserves of ore at Sishen were estimated at 1.34 billion tons containing 60% to 68% iron. The first port facilities at Saldanha Bay were scheduled for completion in 1976, at which time vessels of 100,000 deadweight tons can be handled. Later, berthing facilities will accommodate 250,000 deadweight ton vessels. Cost of the project was expected to exceed $1 billion, more than twice the cost estimated before construction began in 1973.

In 1974, Consolidated African Mines reported that contracts with Japanese buyers had been negotiated for the supply of about 8.5 million tons of manganiferous iron ore during the period 1977–86.

Sweden.—Production and exports of iron ore reached record levels in 1974. Production totaled 36.4 million tons, including 9 million tons of iron ore pellets, 16.8 million tons of direct-shipping ore, and 10.6 million tons of concentrate and natural ore fines. Exports totaled 32.6 million tons, including 7.4 million tons of pellets. Ore shipments, by port, in million tons, were:Narvik, 22.1; Lulea, 8.1; and Oxelösund, 1.5. The average price of Swedish ore products increased about 25% in 1974.

New plants for production of low-phosphorus iron ore concentrate at Grängesberg were expected to be brought onstream by Gränges AB in late 1976. Output of byproduct apatite concentrate was scheduled to increase to 170,000 tons per year. The new plants were estimated to cost $20 million.

United Kingdom.—Production of iron ore continued to decline. Output in 1974 was about half the quantity produced in 1973. One underground mine (the Llanharry in Glamorgan, Wales) was reportedly closed in 1974. Fourteen mines had been operated by divisions of the British Steel Corporation (BSC) in 1973; these included seven open pits in the Corby-Kettering area, operated by the Tubes Division, and seven mines operated by the General Steels Division including four open pits in the Scunthorpe area and three underground mines (Llanharry, in Glamorgan; Beckermet, in Cumberland; and Santon, near Scunthorpe).

Consumption of iron ore in the United Kingdom in 1974 totaled 22.4 million tons, including 18.5 million tons of imported ore and 3.9 million tons of domestically produced ore. The total consumption was 21.5% less than in 1973. Imports of iron ore in 1974 totaled 19.36 million tons, down 14% compared with 1973.

At the Redcar works, BSC's first iron ore pelletizing plant was scheduled for completion in 1975. The plant will employ the grate-kiln pelletizing system designed by the Allis-Chalmers Corp. of Milwaukee, Wis., and will have a production capacity of 3 million tons per year. BSC was also installing a new sinter plant and materials-handling system at the Redcar works, was constructing ore transfer facilities from Port Talbot to the Llanwern works in Wales, and began construction of a new iron ore terminal on the Firth of Clyde at Hunterston, Scotland. The Hunterston terminal will serve the Ravenscraig steelworks and will be capable of accommodating vessels of up to 250,000 deadweight tons. The corporation was also considering construction of a direct-reduction plant for iron ore pellets at Hunterston.

Venezuela.—The iron mining industry was nationalized by the Venezuelan Government, as of January 1, 1975. In December 1974, Iron Mines Co. of Venezuela (a subsidiary of Bethlehem Steel Corp.) and all capital assets of Orinoco Mining Co.[11] (a subsidiary of United States Steel Corp.) were sold to the Government. The Government agreed to sell substantial quantities of ore to both parent companies during the next 5 years.

Both production and exports appeared to set new records in 1974. Exports were estimated at 24 million tons, of which about 65% was destined for the United States. Production of prereduced iron ore (high-iron briquets) by Orinoco Mining Co. was 231,000 tons in 1974, about twice the quantity produced in 1973. Shipments of the briquets (225,000 tons) were apparently destined solely for Venezuelan consumers.

U.S.S.R.—Rising production and exports continued to be reported in Soviet statistics. Exports in 1974 totaled 42.6 million tons, of which 27% went to Czechoslovakia, 26% to Poland, 22% to Romania and Hungary, and 6% to East Germany. Japan, West Germany, and the United Kingdom reported imports of about 1 million tons each from the U.S.S.R. in 1974, and Italy reported imports of 1.65 million tons.

Production of iron ore pellets in 1974 was reported to be 22.9 million tons, about 9% more than in 1973. At least 8.7 million tons of new pelletizing capacity was under construction in 1974.

TECHNOLOGY

In mining equipment, trends toward increasing use of rotary drills for blast holes, larger capacity shovels, and haulage trucks were continued in 1974. Most taconite and natural ore pits on the Mesabi range and all taconite-type operations in Michigan were using rotary drills, although jet-piercer machines were still exclusively used in some taconite operations on the eastern Mesabi, such as at Eveleth Taconite Co. and Reserve Mining Co., and in certain types of iron formations in Michigan. The use of 15-inch-diameter bits was also increasing, and at least one large operation in Minnesota was experimenting with 17½-inch bits. Power shovels with 16-cubic-yard buckets will be used by Hibbing Taconite Co. A power shovel with a radically new front end, designed to make a horizontal pass or slice through the bank, was tested on the Mesabi range by Marion Power Shovel Co. during 1974. The new shovel was said to permit an increase in dipper capacity of up to 33% over conventional machines, and a significant gain in productivity was claimed.

The use of haulage trucks of 150-ton (170-short-ton) capacity was increasing worldwide, and several 180-ton (200-short-ton) units were reportedly shipped to Australia. Most trucks being used in Minnesota and Michigan open pit operations were of 85- to 120-ton capacity, although some 150-ton units were in use and will also be used by Hibbing Taconite Co. A 312-ton (350-short-ton) unit built by the Terex division of General Motors Corp. was being tested at the Eagle Mountain (California) mine of Kaiser Steel Corp. In materials handling, a conveyor system driven by radial tires was introduced by B. F. Goodrich Engineered Systems Co. and Continental Conveyor Co. The system was said to be extendable for miles and to permit the use of lighter weight belting and lower belt tensions, and to reduce the cost per ton of material moved.

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[11] Except for the ore-reduction plant at Puerto Ordaz. This plant, which produces high-iron briquets, was sold to a company owned 51% by the Government and 49% by Orinoco Mining Co.

In milling of taconite, fully autogenous grinding was being used at the Empire and Tilden taconite concentrators in Michigan and will be used in the Hibbing Taconite Co. concentrator in Minnesota in 1976. Semi-autogenous grinding was being used in the Butler and National concentrators in Minnesota, with some shift to wet-grinding methods from the dry methods currently used.

In beneficiation of iron ore, the selective flocculation-desliming process patented by the Bureau of Mines was used prior to cationic flotation of silica in the Tilden concentrator started up by Cleveland-Cliffs Iron Co. in Michigan in late 1974. This was the first commercial plant to use this process for concentration of fine-grained hematitic ore of the taconite type. Application of the technique to beneficiation of nonmagnetic taconite on the Mesabi range was being investigated by the Bureau of Mines in 1974. Also being investigated was magnetizing roasting of the material, followed by magnetic separation and flotation, and high-intensity wet magnetic separation.

A high-intensity separator of the Carousel type was used in beneficiation tests on oxidized taconite on the Mesabi range in 1974, but results were not available. The separator had a processing capacity of 3 to 5 tons per hour and was built by Magnetic Engineering Associates, Inc. Twenty-six high-intensity separators of the Jones type were in commercial use at the Cauê plant of CVRD in Brazil.

The Bureau of Mines continued research on production of magnetic "superconcentrates," containing up to 70% iron and 2% or less of silica, from commercial magnetic concentrates produced at taconite plants in the Lake Superior region. In pilot plant tests, caustic scrubbing followed by flotation of silica produced superconcentrates containing 1.1% to 1.9% silica from commercial concentrates containing 4.2% to 7.0% silica, with iron recoveries of 90% to 93%, at reagent costs of about 33 cents per long ton of superconcentrates produced.[12] A cooperative research effort between the Bureau and Eveleth Taconite Co. was initiated in 1974 to produce superconcentrates containing less than 1.5% silica from plant concentrates containing about 4.5% silica. The project was undertaken because of high interest in the use of prereduced pellets for electric furnace steelmaking.

Expected shortages of natural gas and the rising cost of oil were causing intensive research on the use of pulverized solid fuels for induration of iron ore pellets. The Bureau of Mines was investigating the suitability of western subbituminous coal and lignite for this purpose, and the iron ore producing companies were believed to be testing bituminous coals. The need to evaluate substitute fuels was emphasized by reports that supplies of natural gas would not be adequate to accommodate the 21 million tons of new pellet production capacity expected to be installed in Minnesota by 1978.

The worldwide trend toward increasing production of iron ore pellets continued in 1974. New pellet plants or expansions of existing plants were completed or under construction in at least 10 countries. The United States remained in the forefront of this trend, with 62 million tons of production capacity during 1974, 68 million tons of capacity at yearend, and 21 million tons of new capacity scheduled for completion by 1978.

The Hanna Mining Co. was modifying its pellet plant at Pilot Knob, Mo., in 1974 to produce self-fluxing pellets. In Sweden, LKAB found that substitution of dolomite for limestone in the production of superfluxed pellets greatly reduced disintegration of the material during low-temperature (500° to 600°C) reduction. Such low-temperature conditions were said to be similar to those prevailing in the upper part of a blast furnace stack.[13] In other pellet research, the Bureau of Mines investigated the effect of adding manganese to iron ore pellets, in amounts ranging from 1% to 5%, as a substitute for the use of natural manganiferous ores.[14] Although addition of manganese dioxide or manganiferous iron ore caused no problems in the production of pellets, there was a reduction in reducibility of the product which indicated probable additional smelting expense. Bureau research on metallurgy of pelletized steel-furnace dusts showed that reduction roasting with carbon monoxide, high-carbon wastes, etc., achieved removal of most lead and zinc impurities while increasing the iron content of the pellets.[15]

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[12] Veith, D. L. Superconcentration of Commercial Magnetic Taconite Concentrates by Cationic Flotation. BuMines RI 7852, 1974, 12 pp.

[13] Thaning, G. Reduction Strength of Superfluxed Pellets Made from Rich Magnetite Concentrate. LKAB Special Report, October 1974, 28 pp.

[14] Schluter, R. B., and B. W. Carriere. Influence of Manganese Additions Upon Properties of Iron Ore Pellets. BuMines RI 7870, 1974, 17 pp.

There was a proliferation of projects for direct reduction of iron ore in 1974. New plants were under construction in the United States and at least 12 other countries, most of which had access to abundant supplies of natural gas. Some of these countries (such as Iran, Indonesia, and Saudi Arabia) had relatively little or no proved reserves of iron ore and expected to import that commodity. Most of the new plants will employ the Midrex or HYL reduction processes, although some installations using the Purofer, Fior, and SL/RN processes were being built. In late 1974, total production capacity of new plants under construction or ordered was about 14 million short tons of sponge iron per year with another 17 million tons planned by 1978.[16] Total capacity of plants operating by the end of 1974 was about 5 million tons annually.

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[15] Dressel, W. M., P. G. Barnard, and M. M. Fine. Removal of Lead and Zinc and the Production of Prereduced Pellets from Iron and Steelmaking Wastes. BuMines RI 7927, 1974, 15 pp.

[16] Metal Bulletin Monthly. September 1974, pp. 55-56.

Table 2.—Employment at iron ore mines and beneficiating plants, quantity and tenor of ore produced, and average output per man by district and State

District and State	Average number of men employed (thousands)	Man-hours	Crude ore (thousand long tons)	Usable ore (thousand long tons)	Iron contained [1] (thousand long tons)	Percent (natural)	Average per man-hour: Crude ore	Average per man-hour: Usable ore	Average per man-hour: Iron contained
1973									
Lake Superior:									
Michigan	3	6,490	25,917	11,440	7,210	63.0	3.99	1.76	1.20
Minnesota	11	21,761	155,185	60,021	36,331	60.5	7.13	2.76	1.67
Wisconsin	(2)	418	2,681	956	620	64.9	6.41	2.29	1.48
Total or average [3]	15	28,669	183,783	72,416	44,161	61.0	6.41	2.53	1.54
Southeastern States: Alabama, Georgia, North Carolina	(2)	141	728	317	147	46.4	5.16	2.25	1.04
Northeastern States: New York and Pennsylvania	1	2,292	7,248	2,608	1,680	64.4	3.16	1.14	.73
Western States: Missouri, Montana, Nevada, Utah, Wyoming	2	4,309	13,227	6,871	4,174	60.8	3.07	1.59	.97
Other western States [4]	1	2,924	13,672	5,164	3,076	59.6	4.68	1.77	1.05
Total or average	3	7,233	26,899	12,035	7,250	60.2	3.72	1.66	1.00
Grand total or average [3]	19	38,335	218,658	87,376	53,238	60.9	5.70	2.28	1.39
1974									
Lake Superior:									
Michigan	4	6,340	27,638	11,339	7,153	63.1	4.36	1.79	1.13
Minnesota	11	22,269	153,794	58,484	35,105	60.0	6.91	2.63	1.58
Wisconsin	(2)	410	2,511	899	582	64.7	6.12	2.19	1.42
Total or average [3]	15	29,019	183,943	70,723	42,840	60.6	6.34	2.44	1.48
Southeastern States: Alabama, Georgia, North Carolina	(2)	133	644	287	134	46.7	4.84	2.16	1.01
Northeastern States: New York and Pennsylvania	1	2,137	6,991	2,358	1,527	64.8	3.27	1.10	.71
Western States: Missouri, Montana, Nevada, Utah, Wyoming	2	4,290	12,525	5,986	3,624	60.5	2.92	1.40	.84
Other western States [4]	2	3,539	13,112	4,510	2,701	60.0	3.71	1.27	.76
Total or average [3]	4	7,829	25,636	10,496	6,325	60.3	3.27	1.34	.81
Grand total or average [3]	20	39,118	217,214	83,863	50,826	60.6	5.55	2.14	1.30

[1] Excludes byproduct ore.

[2] Less than ½ unit.

[3] Data may not add to totals shown because of independent rounding.

[4] Includes Arizona, Arkansas, California, Colorado, Idaho, New Mexico, South Dakota, and Texas.

Table 3.—Crude iron ore mined in the United States, by district, State, and variety

(Thousand long tons and exclusive of ore containing 5% or more manganese)

District and State	1973					1974				
	Number of mines	Hematite	Limonite	Magnetite	Total quantity [1]	Number of mines	Hematite	Limonite	Magnetite	Total quantity [1]
Lake Superior:										
Michigan	5	W	--	W	25,917	6	W	--	W	27,638
Minnesota	27	31,154	--	124,031	155,185	27	31,828	--	121,966	153,794
Wisconsin	1	--	--	2,681	2,681	1	--	--	2,511	2,511
Total reportable	33	31,154	--	126,712	183,783	34	31,828	--	124,477	183,943
Southeastern States: Alabama, Georgia, North Carolina	5	--	W	W	728	4	--	W	W	644
Northeastern States: New York and Pennsylvania	4	--	--	7,248	7,248	3	--	--	6,991	6,991
Western States:										
Missouri	2	--	--	4,480	4,480	2	--	--	3,710	3,710
Montana	1	--	--	13	13	2	--	--	30	30
Nevada	3	W	--	W	119	3	W	--	W	139
Utah	4	W	--	W	3,788	3	W	--	W	3,663
Wyoming	3	W	--	W	4,827	3	W	--	W	4,983
Other [2]	11	W	W	W	13,672	12	W	W	W	13,112
Total reportable	24	--	--	4,493	r 26,899	25	--	--	3,740	25,636
Total withheld	--	11,802	3,866	33,382	(3)	--	12,489	3,674	34,016	(3)
Grand total [1]	66	42,956	3,866	171,835	218,658	66	44,317	3,674	169,223	217,214

r Revised.

W Withheld to avoid disclosing individual company confidential data; included with "Total withheld" and "Total quantity."

[1] Data may not add to totals shown because of independent rounding.

[2] Includes Arizona, Arkansas California, Colorado, Idaho, New Mexico, South Dakota, and Texas.

[3] Total withheld data included with "Total quantity" for each respective district or State.

Table 4.—Crude iron ore mined in the United States, by district, State, and mining method

(Thousand long tons and exclusive of ore containing 5% or more manganese)

District and State	1973			1974		
	Open pit	Under-ground	Total quantity [1]	Open pit	Under-ground	Total quantity [1]
Lake Superior:						
Michigan	23,552	2,365	25,917	25,395	2,243	27,638
Minnesota	155,185	--	155,185	153,794	--	153,794
Wisconsin	2,681	--	2,681	2,511	--	2,511
Total reportable	181,418	2,365	183,783	181,700	2,243	183,943
Southeastern States: Alabama, Georgia, North Carolina	728	--	728	644	--	644
Northeastern States: New York and Pennsylvania	W	W	7,248	W	W	6,991
Western States:						
Missouri	--	4,480	4,480	--	3,710	3,710
Montana	13	--	13	30	--	30
Nevada	119	--	119	139	--	139
Utah	3,788	--	3,788	3,663	--	3,663
Wyoming	W	W	4,827	W	W	4,983
Other [2]	13,672	--	13,672	13,112	--	13,112
Total reportable [1]	17,592	4,480	[r] 26,899	16,944	3,710	25,626
Total withheld	9,255	2,820	(3)	8,993	2,981	(3)
Grand total [1]	208,992	9,665	218,658	208,281	8,934	217,214

[r] Revised.

W Withheld to avoid disclosing individual company confidential data; included with "Total withheld" and "Total quantity."

[1] Data may not add to totals shown because of independent rounding.

[2] Includes Arizona, Arkansas, California, Colorado, Idaho, New Mexico, South Dakota, and Texas.

[3] Total withheld data included with "Total quantity" for each respective district or State.

Table 5.—Crude iron ore shipped from mines in the United States, by district, State, and disposition

(Thousand long tons and exclusive of ore containing 5% or more manganese)

District and State	1973			1974		
	Direct to con-sumers	To beneficiating plants	Total quantity [1]	Direct to con-sumers	To beneficiating plants	Total quantity [1]
Lake Superior:						
Michigan	1,954	179,403	26,052	3,170	178,706	27,760
Minnesota			155,305			154,116
Wisconsin	--	2,681	2,681	--	2,511	2,511
Total reportable	1,954	182,084	184,038	3,170	181,217	184,387
Southeastern States: Alabama, Georgia, North Carolina	--	659	659	--	712	712
Northeastern States: New York and Pennsylvania	--	7,381	7,381	--	6,807	6,807
Western States:						
Missouri	--	4,488	4,488	--	3,683	3,683
Montana	13	--	13	30	--	30
Nevada	119	--	119	139	--	139
Utah	W	W	3,805	W	W	3,669
Wyoming	W	W	4,827	W	W	4,983
Other [2]	228	13,487	13,714	310	12,729	13,039
Total reportable	360	17,970	26,961	479	16,412	25,543
Total withheld	1,447	7,186	(3)	1,339	7,314	(3)
Grand total [1]	3,760	215,280	219,040	4,987	212,463	217,449

W Withheld to avoid disclosing individual company confidential data; included with "Total withheld" and "Total quantity."

[1] Data may not add to totals shown because of independent rounding.

[2] Includes Arizona, Arkansas, California, Colorado, Idaho, New Mexico, South Dakota, and Texas.

[3] Total withheld data included with "Total quantity" for each respective district or State.

Table 6.—Usable iron ore produced in the United States, by district, State, and variety

(Thousand long tons and exclusive of ore containing 5% or more manganese)

District and State	1973 Hematite	1973 Limonite	1973 Magnetite	1973 Total quantity[1]	1974 Hematite	1974 Limonite	1974 Magnetite	1974 Total quantity[1]
Lake Superior:								
Michigan	W	--	W	11,440	W	--	W	11,339
Minnesota	21,235	--	38,786	60,021	17,318	--	41,167	58,484
Wisconsin	--	--	956	956	--	--	899	899
Total reportable[1]	21,235	--	39,742	72,416	17,318	--	42,066	70,723
Southeastern States: Alabama, Georgia, North Carolina	--	W	W	317	--	W	W	287
Northeastern States: New York and Pennsylvania	--	--	2,608	2,608	--	--	2,358	2,358
Western States:								
Missouri	--	--	2,625	2,625	--	--	1,862	1,862
Montana	--	--	13	13	--	--	30	30
Nevada	W	--	W	119	W	--	W	139
Utah	W	--	W	2,044	W	--	W	1,850
Wyoming	W	--	W	2,070	W	--	W	2,105
Other[2]	W	W	4,406	5,164	W	W	3,746	4,510
Total reportable[1]	--	--	7,044	12,035	--	--	5,638	10,496
Total withheld	6,989	1,063	8,695	([3])	6,735	998	8,751	--
Total all States[1]	28,224	1,063	58,089	87,376	24,052	998	58,813	83,863
Byproduct ore[4]	--	--	--	293	--	--	--	492
Grand total[1]	28,224	1,063	58,089	87,669	24,052	998	58,813	84,355

W Withheld to avoid disclosing individual company confidential data; included with "Total withheld."

[1] Data may not add to totals shown because of independent rounding.

[2] Includes Arizona, Arkansas, California, Colorado, Idaho, New Mexico, South Dakota, and Texas.

[3] Total withheld data included with "Total quantity" for each respective district or State.

[4] Mostly cinder and sinter obtained from treating pyrites. Ore was treated in New Mexico, Tennessee, and Virginia.

Table 7.—Usable iron ore produced in the United States, by district, State, and type of product

(Thousand long tons and exclusive of ore containing 5% or more manganese)

District and State	1973 Direct shipping ore	1973 Agglomerates	1973 Concentrates	1973 Iron content natural, percent)	1974 Direct shipping ore	1974 Agglomerates	1974 Concentrates	1974 Iron content (natural, percent)
Lake Superior:								
Michigan	1,930	10,750	17,179	68	3,063	10,735	15,082	68
Minnesota		41,601		61		40,944		60
Wisconsin	--	956	--	65	--	899	--	65
Total reportable	1,930	53,307	17,179	61	3,063	52,578	15,082	61
Southeastern States: Alabama, Georgia, North Carolina	--	--	317	46	--	--	287	47
Northeastern States: New York and Pennsylvania	--	W	W	64	--	W	W	65
Western States:								
Missouri	--	2,595	30	65	--	1,828	34	66
Montana	13	--	--	35	30	--	--	42
Nevada	119	--	--	62	139	--	--	60
Utah	W	--	W	55	W	--	W	56
Wyoming	W	W	W	61	W	W	W	61
Other[1]	227	W	W	60	310	W	W	60
Total reportable	359	2,595	30	60	479	1,828	34	60
Total withheld	1,447	6,370	3,842	62	1,339	6,419	2,754	61
Total all States[2]	3,737	62,271	21,368	61	4,880	60,825	18,158	61
Byproduct ore[3]	--	--	293	61	--	--	492	64
Grand total[2]	3,737	62,271	21,661	61	4,880	60,825	18,650	61

W Withheld to avoid disclosing individual company confidential data; included with "Total withheld."

[1] Includes Arizona, Arkansas, California, Colorado, Idaho, New Mexico, South Dakota, and Texas.

[2] Data may not add to totals shown because of independent rounding.

[3] Including magnetite and residues from iron sulfides produced from base metal mines.

Table 8.—Shipments of usable iron ore from mines in the United States in 1974

(Thousand long tons and thousand dollars exclusive of ore containing 5% or more manganese)

District and State	Gross weight of ore shipped				Iron content of ore shipped				Total value [1]
	Direct shipping ore	Agglomerates	Concentrates	Total quantity [1]	Direct shipping ore	Agglomerates	Concentrates	Total quantity [1]	
Lake Superior:									
Michigan	3,170	10,790	15,925	11,602	1,625	6,781	8,544	7,226	213,598
Minnesota		41,140		59,422		25,880		35,605	949,678
Wisconsin	--	899	--	899	--	582	--	582	W
Total reportable [1]	3,170	52,830	15,925	71,924	1,625	33,243	8,544	43,413	1,163,276
Southeastern States: Alabama, Georgia, North Carolina	--	--	265	265	--	--	124	124	1,875
Northeastern States: New York and Pennsylvania	--	W	W	2,383	--	W	W	1,525	46,969
Western States:									
Missouri	--	1,832	33	1,866	--	1,203	23	1,226	W
Montana	30	--	--	30	12	--	--	12	W
Nevada	139	--	--	139	84	--	--	84	990
Utah	1,336		472	1,808	748	--	259	1,007	14,016
Wyoming	3	W	W	2,105	1	W	W	1,275	26,683
Other [2]	313	W	W	4,465	195	W	W	2,679	80,346
Total reportable	1,821	1,832	505	10,413	1,040	1,203	282	6,283	122,035
Total withheld	--	6,412	2,226	(3)	--	4,030	1,254	(3)	54,292
Total all States	4,991	61,074	18,921	84,985	2,665	38,476	10,203	51,345	1,388,447
Byproduct ore [4]	--	--	127	127	--	--	79	79	2,388
Grand total [1]	4,991	61,074	19,048	85,112	2,665	38,476	10,282	51,424	1,390,835

W Withheld to avoid disclosing individual company confidential data; included with "Total withheld" and "Total quantity."

[1] Data may not add to totals shown because of independent rounding.

[2] Includes Arizona, Arkansas, California, Colorado, Idaho, New Mexico, South Dakota, and Texas.

[3] Total withheld data included with "Total quantity" for each respective district or State.

[4] Including magnetite and residues from iron sulfides produced from base metal mines. Ore treated in Tennessee, New Mexico, and Virginia.

Table 9.—Usable iron ore produced in Lake Superior district, by range

(Thousand long tons and exclusive after 1905 of ore containing 5% or more manganese)

Year	Marquette	Menominee	Gogebic	Vermilion	Mesabi	Cuyuna	Spring Valley	Black River Falls	Total[1]
1854–1969	379,785	303,644	320,334	103,528	2,720,453	70,336	8,149	38	3,906,215
1970	10,363	2,394	--	--	56,073	--	--	806	69,636
1971	9,495	2,424	--	--	51,283	--	--	832	64,034
1972	9,131	2,533	--	--	48,998	--	--	888	61,550
1973	9,036	2,404	--	--	60,021	--	--	956	72,416
1974	8,920	2,419	--	--	58,484	--	--	899	70,723
Total	426,680	315,818	320,334	103,528	2,995,312	70,336	8,149	4,419	4,244,574

[1] Data may not add to totals shown because of independent rounding.

Table 10.—Average analyses of total tonnage[1] of all grades of iron ore shipped from the U.S. Lake Superior district

Year	Quantity (thousand long tons)	Content percent[2]					
		Iron	Phosphorus	Silica	Manganese	Alumina	Moisture
1970	69,072	59.36	0.041	7.40	0.39	0.72	4.62
1971	61,776	60.06	.039	7.08	.33	.59	4.09
1972	64,721	60.40	.031	6.76	.30	.52	3.93
1973	76,281	60.66	.030	6.77	.33	.41	3.79
1974	72,194	60.26	.030	6.68	.35	.40	3.94

[1] Railroad weight—gross tons.

[2] Iron and moisture on natural basis; phosphorus, silica, manganese, and alumina on dried basis.

Source: American Iron Ore Association. Iron Ore, 1974, p. 90.

Table 11.—Consumption of iron ore and agglomerates in the United States in 1974

(Thousand long tons and exclusive of ore containing 5% or more manganese)

State	Iron ore and concentrates[1]		Agglomerates[2]			
	Blast furnaces	Steel furnaces	Blast furnaces	Steel furnaces	Miscellaneous[3]	Total reportable
Alabama, Kentucky, Texas	2,905	W	7,601	W	W	10,506
California, Colorado, Utah	3,759	W	6,064	W	W	9,823
Ohio and West Virginia	5,089	W	22,766	W	W	27,855
Illinois and Indiana	2,422	W	31,387	W	W	33,809
Michigan	325	W	10,004	W	W	10,329
Maryland, New York, Pennsylvania	12,724	W	30,724	W	W	43,466
Undistributed	--	1,142	--	518	717	2,372
Total	27,242	1,142	108,546	518	717	138,160

[e] Estimate. W Withheld to avoid disclosing individual company confidential data.

[1] Not including pellets or other agglomerated products.

[2] Includes 61,102,209 tons of pellets produced at U.S. mines and 10,455,366 tons of foreign pellets and other agglomerates.

[3] Includes iron ore consumed in production of cement and ferroalloys, and iron ore shipped for use in manufacture of paint, ferrites, and heavy media.

Table 12.—Iron ore consumed in production of agglomerates at iron and steel plants in 1974, by State

(Thousand long tons)

State	Iron ore consumed [1]	Agglomerates produced
Alabama, Kentucky, Texas	3,010	3,597
California, Colorado, Utah	1,882	2,136
Ohio and West Virginia	3,463	4,956
Illinois, Indiana, Michigan	7,217	9,580
Maryland, New York, Pennsylvania	13,805	16,274
Total [2]	29,376	36,544

[1] Includes domestic and foreign ores.

[2] Data may not add to totals shown because of independent rounding.

Table 13.—Beneficiated iron ore shipped from mines in the United States [1]

(Thousand long tons and exclusive of ore containing 5% or more manganese)

Year	Beneficiated ore	Total iron ore	Proportion of beneficiated to total (percent)
1970	79,779	87,176	91.5
1971	70,456	77,106	91.4
1972	72,011	77,884	92.5
1973	86,894	90,654	95.9
1974	79,995	84,985	94.1

[1] Beneficiated by further treatment than ordinary crushing and screening. Excludes byproduct ore.

Table 14.—Production of iron ore agglomerates [1] in the United States, by type

(Thousand long tons)

Type	Agglomerates produced	
	1973	1974
Sinter, nodules, cinder	[r] [2] 38,030	[3] 37,762
Pellets	61,196	59,719
Total	[r] 99,226	97,481

[r] Revised.

[1] Production at mines and consuming plants.

[2] Includes 20,300,000 tons of self-fluxing sinter.

[3] Includes 18,715,000 tons of self-fluxing sinter.

Table 15.—Stocks of usable iron ore at mines,[1] Dec. 31, by district

(Thousand long tons)

District	1973	1974
Lake Superior	4,124	2,878
Southeastern States	617	636
Northeastern States	5,336	5,083
Western States	798	808
Total [2]	10,876	9,405

[1] Excluding byproduct ore.

[2] Data may not add to totals shown because of independent rounding.

Table 16.—Average value of usable iron ore [1] shipped from mines or beneficiating plants in the United States in 1974

(Dollars per long ton)

Type of ore	District			
	Lake Superior	Southeastern	Northeastern	Western
Direct-shipping, hematite and magnetite	6.47	--	--	7.85
Concentrates, hematite and magnetite	10.30	W	W	11.03
Concentrates, limonite	--	7.07	--	W
Agglomerates	18.86	--	W	19.02

W Withheld to avoid disclosing individual company confidential data.

[1] F.o.b. mine or plant. Excludes byproduct ore.

Table 17.—U.S. exports of iron ore, by country

(Thousand long tons and thousand dollars)

Country	1972		1973		1974	
	Quantity	Value	Quantity	Value	Quantity	Value
Canada	1,442	20,067	2,266	32,869	1,814	30,061
France	(1)	3	(1)	1	27	329
Germany, West	44	122	17	126	(1)	(1)
Japan	608	6,553	457	4,819	439	4,691
Mexico	--	--	6	70	1	14
Sweden	--	--	--	--	40	20
Other	1	31	1	37	2	33
Total	2,095	26,776	2,747	37,922	2,323	35,148

[1] Less than ½ unit.

Table 18.—U.S. imports for consumption of iron ore, by country

(Thousand long tons and thousand dollars)

Country	1972		1973		1974	
	Quantity	Value	Quantity	Value	Quantity	Value
Angola	--	--	40	273	260	3,312
Argentina	(1)	12	31	340	--	--
Australia	687	9,245	464	5,840	638	7,292
Belgium-Luxembourg	--	--	17	160	--	--
Brazil	1,115	11,990	3,183	36,295	6,572	85,259
British West Africa	--	--	--	--	38	365
Canada	18,168	247,757	21,628	311,893	19,702	341,577
Chile	308	2,877	205	1,712	296	2,883
Gabon	--	--	--	--	57	577
Germany, West	--	--	(1)	(1)	17	590
Liberia	2,761	22,740	2,734	23,667	2,730	29,113
Mauritania	40	687	47	418	--	--
New Guinea	--	--	--	--	48	470
Nigeria	85	729	--	--	--	--
Peru	1,318	15,048	1,501	19,685	1,810	27,325
Philippines	11	283	25	633	15	392
Sweden	273	3,952	273	4,385	335	6,215
U.S.S.R	--	--	--	--	126	1,622
Venezuela	10,926	99,951	13,148	128,169	15,377	189,188
Other	69	663	(1)	18	8	118
Total	35,761	415,934	43,296	533,488	48,029	696,298

[1] Less than ½ unit.

Table 19.—Iron ore, iron ore concentrates, and iron ore agglomerates: World production by country

(Thousand long tons)

Country[1]	Gross weight[2]			Metal content[3]		
	1972	1973	1974[p]	1972	1973	1974[p]
North America:						
Canada[4]	[r] 38,919	48,119	49,187	24,149	29,699	30,343
Mexico[5]	5,009	5,107	5,476	3,005	3,064	3,286
Panama	76	[e] 80	--	[e] 46	[e] 50	--
United States[6]	75,434	87,669	84,355	46,015	53,478	51,457
South America:						
Argentina	[r] 255	234	[e] 240	113	104	[e] 110
Bolivia (exports)	[r] 50	10	--	32	6	--
Brazil	45,737	54,150	69,900	29,729	35,198	45,421
Chile	8,504	9,253	10,129	5,219	5,830	6,384
Colombia	409	472	502	[e] 170	203	[e] 220
Peru	9,266	8,823	9,375	5,885	5,769	[e] 6,100
Uruguay	1	4	--	[e] 1	[e] 2	--
Venezuela	[r] 18,206	22,745	26,007	11,106	13,874	15,864
Europe:						
Albania[7]	[r] [e] 400	378	[e] 400	[e] 140	[e] 132	[e] 140
Austria	4,067	4,144	4,178	1,315	1,314	1,290
Belgium	111	114	121	33	34	36
Bulgaria	3,156	2,729	2,642	1,035	819	792
Czechoslovakia	[r] 1,556	1,646	1,661	467	494	498
Denmark	15	10	6	[e] 5	[e] 3	[e] 2
Finland[8]	979	880	922	643	575	594

See footnotes at end of table.

Table 19.—Iron ore, iron ore concentrates, and iron ore agglomerates: World production by country—Continued

(Thousand long tons)

Country [1]	Gross weight [2]			Metal content [3]		
	1972	1973	1974 p	1972	1973	1974 p
Europe—Continued:						
France	r 53,389	53,375	53,407	16,264	15,423	16,452
Germany, East [9]	264	51	--	e 60	e 10	--
Germany, West	r 4,749	4,989	4,369	1,693	1,770	1,540
Hungary	684	670	536	e 170	e 170	e 120
Italy [10]	606	502	649	267	221	286
Luxembourg	4,051	3,723	2,644	1,215	1,117	793
Norway	r 3,820	3,907	3,856	2,478	2,540	2,506
Poland	1,630	1,391	1,276	489	417	383
Portugal [11]	r 43	35	24	19	15	10
Romania	3,308	3,183	e 3,100	1,075	1,034	e 1,000
Spain	r 6,666	7,210	8,447	3,298	3,582	4,143
Sweden	r 33,442	34,179	36,371	20,400	20,849	22,187
U.S.S.R	204,840	212,691	221,446	120,855	125,488	130,653
United Kingdom	r 8,905	6,993	3,545	2,479	1,923	993
Yugoslavia	3,897	4,597	4,954	1,364	1,609	1,734
Africa:						
Algeria	3,611	3,085	3,760	1,950	1,666	2,030
Angola	r 4,755	5,957	e 5,700	2,877	e 3,600	e 3,400
Egypt	421	646	1,281	210	323	641
Kenya	--	12	19	--	7	e 12
Liberia	22,153	23,170	23,409	13,518	14,134	14,280
Mauritania	r 9,106	10,314	11,482	5,919	5,542	7,233
Morocco	r 229	368	523	132	212	e 330
Rhodesia, Southern e	500	500	500	300	300	300
Sierra Leone	2,284	2,369	1,982	1,439	1,491	1,249
South Africa, Republic of [12]	11,046	10,782	10,659	6,904	6,739	6,662
Swaziland	1,952	2,113	2,442	e 1,230	1,331	e 1,540
Tunisia	876	796	802	477	423	e 430
Asia:						
China, People's Republic of e	r 51,000	r 55,000	59,000	25,500	27,500	29,500
Hong Kong	160	148	157	85	79	83
India	34,989	34,841	34,307	21,313	21,253	21,476
Indonesia	262	277	341	152	156	198
Iran [13]	96	837	984	e 60	510	e 600
Japan [14]	r 1,325	991	765	774	578	436
Korea, North e	8,500	r 8,800	9,300	3,400	3,500	3,700
Korea, Republic of	r 407	459	485	228	257	272
Malaysia	r 504	501	466	288	281	261
Philippines	2,170	2,219	1,583	1,248	1,276	910
Taiwan	28	24	e 25	14	12	e 12
Thailand	27	36	36	14	e 18	e 18
Turkey	1,928	2,515	2,219	1,095	1,398	1,234
Oceania:						
Australia	r 63,384	83,472	95,146	40,760	53,042	60,192
New Zealand [15]	1,358	2,147	2,316	774	1,224	1,341
Total	r 765,465	r 836,442	879,414	431,885	473,668	503,677

e Estimate. p Preliminary. r Revised.

[1] In addition to the countries listed, Cuba and North Vietnam may produce iron ore, but definitive information on output, if any, is not available.

[2] Insofar as availability of sources permit, gross weight data in this table represent the nonduplicative sum of marketable iron ore, iron ore concentrates, and iron ore agglomerates produced by each of the listed countries. Moreover, concentrate and agglomerates produced from imported ores are excluded, under the assumption that the ore from which they are produced has been credited as marketable ore in the country where it was mined.

[3] Data represent actual reported weight of contained metal or are calculated from reported metal content. Estimated figures are based on latest available iron content reported except for the following countries, for which grades are U.S. Bureau of Mines estimates: Panama, Uruguay, Albania, Denmark, East Germany, Hungary, Southern Rhodesia, the People's Republic of China, and North Korea.

[4] Gross weight and metal content of shipments of usable iron ore, dry tons, including byproduct ore.

[5] Gross weight calculated from reported iron content based on a grade of 66.67% iron.

[6] Includes byproduct ore.

[7] Nickeliferous iron ore.

[8] Includes magnetite concentrate, pelletized iron oxide (from pyrite sinter) and roasted pyrite (purple ore).

[9] Includes "roasted ore," presumably pyrite sinter, not separable from available sources.

[10] Excludes iron oxide pellets produced from pyrite sinter.

[11] Includes manganiferous iron ore.

[12] Includes byproduct magnetite as follows in thousand long tons: 1972—2,952; 1973—2,068; 1974—2,148. Data erroneously listed in previous editions of this chapter as including manganiferous iron ore.

[13] Year beginning March 21 of that stated.

[14] Concentrates including concentrate derived from iron sand as follows in thousand long tons: 1972—539; 1973—274; 1974—128.

[15] Largely concentrates from magnetite-titanium sands.

Iron and Steel

By Horace T. Reno[1]

The iron and steel industry of the world produced slightly more steel in 1974 than it did in 1973, but in the last half of the year, output slacked off in European countries and in Japan. In the United States the industry operated at capacity through 10 months until slowed down by a labor strike in the coal mines. Steel plants in the Soviet Union operated at capacity throughout the year, and the U.S.S.R. regained the lead from the United States as the world's leading steel producer.

The steel industry of the United States produced 145.7 million tons of raw steel[2] ingots and castings, just 3% less than a record established in 1973. The industry shipped 109.5 million tons of steel mill products, 2% less than the 1973 record. Coking coal and electric power shortages plagued the industry throughout the year. The industry engaged in a concerted effort to conserve energy and continued its high rate of investment in equipment to control effluents damaging to the environment.

Domestic demand for iron and steel products exceeded supply throughout the year. The shortage of roof bolts, which was critical in 1973, was eased, but oil country goods continued in short supply. There was a shortage of bailing wire and of heavy plate for shipbuilding, industrial machinery, and other capital goods, and the Secretary of Agriculture asked the industry to increase its output of tinplate to prevent loss of food products.

According to the American Iron and Steel Institute (AISI), steel mill shipments of construction and contractors' products were 5% more than in 1973. Shipments to service centers and distributors were 2% more. Shipments to the machinery industry were about the same, but shipments to the automotive industry were 18% less in 1974 than in 1973. Exports of steel mill products were up 41%, while imports were up 7%.

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[1] Physical scientist, Division of Ferrous Metals.

[2] The term raw steel, as used by the American Iron and Steel Institute, includes ingots, steel castings, and continuously cast steel. It corresponds to the term crude steel as used by the United Nations.

Table 1.—Salient iron and steel statistics
(Thousand short tons)

	1970	1971	1972	1973	1974
United States:					
Pig iron:					
Production	91,293	81,382	88,876	r 101,318	95,477
Shipments	91,272	81,332	89,053	r 101,628	95,941
Exports	310	34	15	15	101
Imports for consumption	249	306	637	446	342
Steel: [1]					
Production of raw steel:					
Carbon	117,411	107,007	117,698	132,747	126,608
Stainless	1,279	1,263	1,564	1,889	2,150
All other alloy	12,824	12,173	13,979	16,163	16,962
Total	131,514	120,443	133,241	150,799	145,720
Index [2]	103.4	94.7	104.5	118.5	114.5
Total shipments of steel mill products	90,798	87,038	91,805	111,430	109,472
Exports of major iron and steel products	7,657	3,526	3,546	4,962	6,988
Imports of major iron and steel products [3]	13,861	18,744	18,158	r 15,608	16,746
World production:					
Pig iron	475,000	474,000	r 500,000	r 552,000	567,000
Raw steel (ingots and castings)	655,000	640,000	693,000	r 767,000	779,000

r Revised.

[1] American Iron and Steel Institute. Includes ingots, continuous cast steel, and all other cast forms.

[2] Based on average production in 1967 as 100.

[3] Data not comparable for all years.

PRODUCTION AND SHIPMENTS OF PIG IRON

Domestic production of pig iron totaled 95.5 million tons in 1974, a decrease of 5.8 million tons or 6% less than that produced in 1973. Average production of pig iron per blast-furnace-day decreased to 1,735.1 tons compared with 1,771.7 tons in 1973 and 1,789.6 tons in 1972 according to AISI. A total of 163 furnaces were in blast at the beginning of the year, including one that produced ferroalloys. At yearend the total number in blast had decreased to 136 with one producing ferroalloys. There were 204 producing blast furnaces at the beginning of the year, and 197 at yearend, of which 11 were being relined and 3 rebuilt.

Metalliferous Materials Consumed in Blast Furnaces.—For each ton of pig iron produced in 1974, an average of 1.665 tons of metalliferous materials was consumed in blast furnaces. Total net iron ore consumed in blast furnaces including agglomerates was 150.3 million short tons. The total tonnage of iron ore including manganiferous ore consumed by agglomerating plants at or near the blast furnaces in producing 40.9 million tons of agglomerates was 33.2 million tons. The remainder consisted of mill scale, coke, limestone, dolomite, and small amounts of other materials. Domestic pellets charged to the blast furnaces totaled 68.2 million tons, and sinter charged was 41.6 million tons. Pellets and other agglomerates from foreign sources added an additional 11.6 million tons.

Blast furnace oxygen consumption totaled 25.8 billion cubic feet according to AISI, compared with 21 billion cubic feet in 1973 and 15.5 billion cubic feet in 1972.

Data reported to the Bureau of Mines by the iron and steel industry showed that blast furnaces, through tuyere injection, consumed 16 billion cubic feet of natural gas, 4 billion cubic feet of coke oven gas, 239.6 million gallons of oil, 92.3 tons of tar, pitch, and miscellaneous fuels, and 213,583 tons of bituminous and 23,469 tons of anthracite coal in 1974.

PRODUCTION AND SHIPMENTS OF STEEL

The domestic steel industry produced 145.7 million tons of raw steel in 1974, 3% less than the record 151.0 million tons produced in 1973. The industry worked at practical capacity through the first three quarters of the year, but a labor strike in the coal mines and the need for long postponed maintenance cut back production in the last quarter. The 1974 steel index, based on production in 1967 as 100, was 114.5 compared with 118.5 in 1973 and 104.5 in 1972. Of the total, 56% was produced by the basic oxygen process (BOP), 24% by open-hearth furnaces and 20% by electric furnaces. Shipments of steel products for the year totaled 109.5 million tons, 2% less than the 111.4 million tons shipped in 1973. Shipments to the automotive market totaled 18.9 million tons, 18% less than in 1973, but shipments of oil country goods were up 21%, and shipments to the construction industry were up 4%.

Materials Used in Steelmaking.—Metallics charged to domestic steel furnaces in 1974, per ton of steel produced, averaged 1,240 pounds of pig iron, 1,143 pounds of scrap, and 25 pounds of iron ore, including agglomerates. In 1973, comparable quantities were 1,259 pounds of pig iron, 1,104 pounds of scrap, and 32 pounds of iron ore, including agglomerates.

According to AISI, steelmaking furnaces consumed 643,976 tons of fluorspar, 2.6 million tons of limestone, 7.9 million tons of lime, and 1.1 million tons of other fluxes. Oxygen consumption in steelmaking totaled the equivalent of 212.6 billion cubic feet compared with 215.1 billion cubic feet in 1973.

CONSUMPTION OF PIG IRON

Pig iron consumed in steelmaking totaled 93.1 million tons. Basic oxygen converters consumed 66.6 million tons; open hearths, 22.5 million tons; and electric furnaces, 1.2 million tons. An additional 2.8 million tons was consumed by iron foundries and miscellaneous users, primarily for charging cupola furnaces. Also, approximately 3.7 million tons in the form of molten metal was used in making ingot molds and direct castings.

PRICES

Throughout 1974 the prices of iron and steel products on world markets were above those in the United States for the first time since the steel industries were rebuilt in Europe and Japan after World War II. Price controls in the United States and the sellers' market throughout the world, resulted in an imbalance between foreign and domestic prices that ranged from $50 to $150 a ton through the first 4 months of the year. By yearend, however, the foreign prices for some grades of steel were equal to, or slightly above, prices for domestic steels.

In the United States steel mill products and pig iron were under strict price controls for the first 4 months of 1974. At the beginning of the year, most producers had petitions to raise prices pending before the Cost of Living Council. The Council allowed the steel companies to pass through scrap cost increases incurred after June 1, 1973, but postponed its ruling on a petition for a 5.3% price increase on heavy steel products until January 25. On that date the Council allowed companies with annual product sales of less than $50 million to raise prices on steel wire products, cold-rolled steel shapes, steel pipe, and electrometallurgical products, and allowed the major steel companies to increase prices on selected steel mill products from 2% to 9.5%, apparently depending on volume of the product and the complexity of the steelmaking processes involved.

On March 1 the Council ruled that domestic steel companies could raise prices on a wide range of steel products by 5% to 11% to enable the companies to recover on a dollar-for-dollar basis higher material and fuel costs incurred since November 1973. Accordingly, major steel producers increased product surcharges early in April by $50 to $78 per ton to pass through the higher scrap iron and steel prices.

Price controls on iron and steel, iron ore, and scrap iron were removed April 30. The major steel producers increased base prices for cold-rolled sheet by $20 a ton, hot-rolled sheet by $17.50 per ton, hot-rolled bars by $3.50 per ton, and carbon plate by $7 per ton. The industry continued to raise its prices selectively through May and June, but by the end of June prices had been stabilized and were relatively constant throughout the last half of the year.

The composite price for pig iron, according to Iron Age, began the year at $78.16 per short ton in January, increased to $81.12 a ton in March, was unchanged through May, but increased to $134.50 per ton in June, $155 per ton in July, to $170.56 per ton in November, and to $175.03 per ton in December. Effective December 27, 1974, the composite price for pig iron was raised to $180.50 per ton. The composite price for finished steel was $189.60 per ton at the beginning of the year, remained unchanged for the first 3 months, increased to approximately $200 a ton in April, $220 a ton in May and June, and was raised to $240.88 per ton in July. At yearend the composite price was $248.66 per ton.

FOREIGN TRADE

The worldwide steel industry boom which changed the pattern of U.S. foreign trade in steel in 1973 continued to affect it during the first part of 1974. Imports of steel mill products in the first 5 months of the year were the lowest since the first month of 1970. But, in the last half of the year imports increased, probably in anticipation of a strike by coal miners. By October imports reached 2.1 million net tons, the highest for 1 month since June 1971. Imports remained about 750,000 tons higher than the 1973 average through the remainder of the year. Imports for the entire year totaled 16,746,000 tons, 7% more than the quantity imported in 1973. Imports of carbon steel were 5% higher than in 1973, but imports of alloy steel were 5% less, while imports of stainless steel, 176,000 tons, were 38% more than the quantity imported in 1973. The European Community (EC) countries supplied 40% of the total, Japan 39%, Canada 8%, and other countries the remaining 13%.

The EC countries shipped 6,423,000 tons of steel to the United States, 2% less than in 1973. Imports of alloy steel from the Community were 4% less, but imports of stainless steel were 26% more than from the Community in 1973.

Japan supplied 6,158,000 tons, 9% more than in 1973, and 39% of the total of U.S. imports of steel. Although it supplied 35% of the alloy steel total, alloy steel imports from Japan were 14% less than those in 1969. Japan supplied 45% of the total of stainless steel imports into the United States, 65% more than in 1973.

Canada supplied only 8% of total iron and steel product imports, but 18% of the total imports of alloy steel, and 13% of the imports of stainless steel. Alloy steel imports were 42% higher than those from Canada in 1973, and stainless steel imports were 18% higher. Sweden supplied 10% of the total imports of alloy steel, 14% less than it supplied in 1973. It supplied 13% of the total imports of stainless steel, about the same quantity that it supplied in 1973.

Imports of iron and steel products in the United States in 1974 were valued at $5.6 billion, 83% more than in 1973. Iron and steel mill product exports were valued at $3.0 billion, nearly twice the value of 1973 exports. Thus, there was an unfavorable balance in steel mill trade of $2.6 billion.

WORLD REVIEW

NORTH AMERICA

Canada.—Canadian iron and steel companies continued their program of modernization and expansion. Among the significant works completed in 1974, the Steel Co. of Canada Ltd. (STELCO) completed a steel furnace plant at its Edmonton works, installed an 80-ton electric arc furnace at the McMaster works at Contrecoeur, and completed installation of a spiral weld tube mill at its Page-Hersey works near Welland, Ontario. The Sydney Steel Corp. (SYSCO) completed a rail-finishing mill, a 450-ton-per-day oxygen plant, installed a new hot blast stove, and rebuilt one blast furnace.

The Canadian industry operated at close to its practical capacity through most of the year. It produced 15 million tons of crude steel. Steel imports exceeded exports by approximately 1.4 million tons. Therefore, Canadian indicated crude steel equivalent consumption in 1974 was 16.4 million tons compared with the record 15.6 million tons in 1973.

STELCO announced plans to build a $2 billion steel mill on a 6,600-acre green field site between Port Dover and Nanticoke on the north shore of Lake Erie. The company started clearing the land to provide for the new plant.

After due investigation the U.S. Treasury Department found that pig iron from Canada was no longer being sold or was likely to be sold in the United States at less than fair value within the meaning of the Antidumping Act of 1921.

SOUTH AMERICA

Argentina.—The Argentine Government, in order to increase the Nation's steelmaking capacity, authorized formation of a corporation with majority State participation to construct and operate an integrated steel mill. An international tender was made for the selection of an associate company, but at yearend satisfactory responses had not yet been received.[8]

In view of the continued shortage of steel plate and billets in Argentina, the Government by Decree 1465, dated November 15, 1974, eliminated the duty on steel plate having a carbon content below 0.4% and on billets with under 0.25% of carbon content, but restricted imports to 250,000 tons of hot-rolled steel plates and 50,000 tons of cold-rolled plates. The regulations were valid through December 31, 1975.

Bolivia. — The Bolivian-Brazilian-Argentinian cooperative project to build an iron ore mining and iron and steel plant industrial complex based on the Mutún iron ore deposits, advanced significantly when Bolivia and Argentina agreed on an exchange of goods and raw materials from the project. Under the agreement, Argentina is to buy annually a minimum of 1.1 million short tons of iron ore concentrates or pellets, 992,070 short tons of sponge iron, 330,690 short tons of semifinished steel products, and 440,920 short tons of semifinished steel. Furthermore, Argentina is to finance Bolivian hydrocarbon exploration and exploitation in a yet undefined area. Bolivia is to supply Argentina with 282.5 million cubic feet per day of natural gas from presently known reserves for a period of 10 years. Furthermore, Bolivia is to supply the same quantity for 10 years from yet to be discovered natural gas deposits, after first fulfilling its own needs.[4]

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[8] U.S. Embassy, Buenos Aires, Argentina. State Department Airgram A-210, July 1, 1974, 7 pp.; and Airgram A-378, Nov. 25, 1974, 2 pp.

Empresa Siderúrgica Boliviana S. A. (SIDERSA), the Bolivian-owned iron and steel concern, arranged for a $10 million loan from Brazil to finance feasibility studies on the Mutún project.[5]

Brazil.—Brazil continued to suffer from a serious steel shortage. Its steel imports in 1974 cost more than $1.5 billion, although the first program established by the National Steel Expansion Plan of 1970 was essentially completed by the beginning of the year. Therefore early in the year the Government, through the Conselho Consultivo da Industria Nacional de Siderúrgica (CONSIDER), revised its program as follows: (1) Expand Brazil's steelmaking capacity to 24 to 26 million tons at a cost of $6 billion; (2) accelerate expansions at the Cia. Siderúrgica Nacional (CSN), Usinas Siderúrgicas de Minas Gerais, S. A. (USIMINAS), and Cia. Siderúrgica Paulista (COSIPA); (3) form new steel companies; (4) reorganize the managerial and financial structure of the steel industry; and (5) promote foreign investment in the steel sector.[6]

Under this new program, Brazil is to become a net exporter of steel in the 1980's. SIDERBRAS S.A., the Government holding company, formed in 1973 to act as CONSIDER's investment and administrative agent, is to handle the financial arrangements under the program. It issued criteria for utilizing available credits, and it stipulated that all equipment purchases shall be made through international bidding in full compliance with the general rules of the World Bank and Inter-American Development Bank (IDB).

Among the new steel plants, work was started at the Tubarão complex, plans for which were announced in 1973, and planning was started for the Itaqui complex near the Port of São Luis, Maranhão. The Itaqui complex is to be coordinated with development of iron ore deposits at Carajas in the State of Pará.

The three large companies with existing steel plants, CSN, USIMINAS, and COSIPA, sent delegations to the United States, Europe, and Japan to discuss financing expansion equipment with foreign governments and international financial institutions. In December IDB approved loans of $63 million to CSN and $40 million to COSIPA, for 15 years at 8% annual interest.

Chile.—The iron and steel industry of Chile produced 700,000 short tons of steel ingots in 1974, 16% more than it produced in 1973. Compañía de Acero del Pacífico, S.A. (CAP), the State-owned vertically integrated company that produces more than 90% of Chile's iron and steel, renewed its capital investment program to expand its steel mill at Huachipato.[7] The Government of Chile approved limited expenditure of local currency for the CAP expansion project. The amount of local currency available limits the rate of expansion.

Colombia.—The Instituto Latinoamericano del Fierro y Acero (ILAFA) held its annual meeting in Bogotá in October. Most of the discussions at the conference were concerned with technology for using low-grade noncoking coal, which is abundant in Latin America. The major operating problems in the Latin American iron and steel industry in 1974 were caused by shortages of scrap metal and high-grade coal. These problems led conference participants to forecast increased use of direct reduction processes. Extended use of direct reduction would eliminate the scrap and coking coal problems; nevertheless, Colombia's only integrated steelmaker, Acerías Paz del Rio, S.A. planned to expand its operations with a blast furnace producing pig iron.[8]

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[4] U.S. Embassy, La Paz, Bolivia. State Department Airgram A–187, Oct. 7, 1974, 7 pp.

[5] U.S. Embassy, La Paz, Bolivia. State Department Airgram A–176, Sept. 17, 1974, 7 pp.

[6] U.S. Consulate, Rio de Janeiro, Brazil. State Department Airgram A–32, Mar. 8, 1974, 9 pp.; and A–05, Jan. 22, 1975, 33 pp.

[7] U.S. Embassy, Santiago, Chile. State Department Airgram A–41, Feb. 27, 1975, 7 pp.

[8] U.S. Embassy, Bogota, Colombia. State Department Airgram A–218, Dec. 24, 1974, 4 pp.

EUROPE

It was a record year for the steel industries of Europe. Among those countries in the European Community, only the United Kingdom did not exceed its previous record. Among other Western European countries that produce more than a million tons of steel a year, only Norway did not establish a record. All Eastern European countries except Bulgaria made raw steel output records. The EC countries produced 172 million tons of steel, and other Western European countries produced 32 million tons. The Eastern European countries produced 204 million tons. Thus, the steel industry of Europe produced 408 million tons of steel, 4% more than the record established in 1973.

European Community (EC).—*France.*—The French iron and steel industry operated at practical capacity through the first half of the year and produced a record 29.8 million tons of raw steel in 1974, 7% more than in 1973. The first stage of construction of the iron and steel complex at Fos-sur-Mer was on schedule. Arrangements had not yet been made by yearend to finance the second stage of construction. Union Sidérurgique du Nord et de l'Est de la France S. A. (Usinor) reported that a group of steel producers have set up an organization to supply them with prereduced iron.[9]

Germany, West.—There was a strong increase in demand for West Germany's steel, but the domestic market was weak. Steelmakers increased their output 7% to 59 million tons compared with the 55 million produced in 1973. The trend to larger steel companies continued as Rheinstahl AG was merged into August Thyssen-Hütte A.G.[10]

Italy.—Italy's steel industry produced 26.2 million tons of raw steel in 1974, 13% more than it produced in 1973. Despite opposition from environmentalists, the Italian Interministerial Programming Committee (CIPE), approved construction of an iron and steel works at Gioia Tauro by ITALSIDER, S.p.A. Gioia Tauro will be Italy's fifth steelmaking center.[11]

United Kingdom.—The British steel industry started the year with its output restricted by a power shortage caused by labor trouble in the coal mines. The coal miners had refused to work overtime in the last 7 weeks of 1973 and struck February 9, 1974, after which steel output was cut back progressively in 10% increments to reach less than 50% of normal output before the strike was settled. In addition to the trouble caused by the coal strike, the industry continued to be plagued by wildcat walkouts in its own operations. British Steel Corp. (BSC) kept its plant at Llanwern closed until the unions there agreed to abandon wildcat walkouts.

The steel industry operated normally in the last half of the year, but its output of 24.7 million tons was down 16% from that of 1973. There was a severe shortage of steel in the United Kingdom throughout most of the year, although steel imports were up 40% from those of 1973 and exports were down 23%. Despite all its troubles, BSC reported profits of $125 million for the year, and its expansion projects were essentially on schedule. Construction was started on the corporation's first 5,000-ton-per-day blast furnace at Llanwern, and it was announced that a 10,000-ton-per-day furnace would be built for Redcar at Teesside.

This was the first full year that the United Kingdom had been a member of the EC, but the BSC was unable to take advantage of membership. The Government restricted exports and would not permit the BSC to raise its prices to those prevailing on the Continent. Furthermore, BSC's limited output did not provide sufficient steel for membership in the Community to make much difference in marketing. Nevertheless, the European Coal and Steel Community provided funds for British workers who lost their jobs because of BSC's new facilities.

BSC made formal arrangements for cooperative research with other steelmakers within the European Coal and Steel Community. Researchers at BSC explored possible uses for waste heat in steelworks, and studied ways to increase the flexibility of the energy supply. They studied the fragmentation of scrap at low temperature and the direct reduction of iron ore using natural gas. The European Nuclear Steelmaking Club (ENSEC), formed through BSC's initiative in 1973, had three working parties to determine the research and development needed for eventual application of nuclear heat to making steel.

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[9] Iron and Steel Engineer, Annual Review. Developments in the Iron and Steel Industry During 1974. V. 52, No. 1, p. D-31.

[10] American Metal Market. Rheinstahl-Thyssen Merger is Approved. V. 81, No. 169, Aug. 29, 1974, p. 3.

[11] U.S. Bureau of Mines. Iron and Steel: Italy. Mineral Trade Notes, v. 71, No. 6, June 1974, pp. 8, 9.

Western Europe.—*Austria.*—The Austrian iron and steel industry produced a record 5.2 million tons of raw steel in 1974, 11% more than it produced in 1973. The nationalized steel combine, VÖEST-Alpine A.G., essentially completed its 5-year modernization and expansion program at the Linz plant. The program included modernization and extension of two existing blast furnaces, a third LD plant, enlargement of the existing sintering plant, a dust collection plant, an exhaust-cleaning system, a new continuous casting plant, a hydrochloric acid pickling plant, and an acid recovery system.[12]

Spain.—The Spanish steel industry produced a record 12.4 million tons of steel in 1974, 4% more than it produced in 1973. There was a high level of economic activity in 1974 throughout Spain.

The Spanish Government established a national iron and steel plan for the period 1974–82 by Decree 669, March 14, 1974. The plan anticipates steel consumption increasing from 11 million tons in 1974 to over 20 million tons in 1982. Under the plan, small, nonintegrated steel companies will be permitted to work together to increase their efficiency through joint research and marketing, and the program continues incentives and benefits that were provided under the decree of 1969.

Under the new plan selection and quality of iron and steel products will be standardized at the European level. Joint action will be permitted to achieve production specialization and commercialization in common and unified research. Costs will be allowed to be competitive at the international level, and iron and steel companies planning to increase their scrap consumption, as a result of installing electric furnaces, will be obligated to install sufficient prereduction facilities with capacity to substitute prereduced products for at least two-thirds of their total metallics consumption.

In order to obtain better geographic distribution in the Nation's steel industries under the plan, mini-mills are to be constructed at Campo de Gibraltar and in the major industrial zone of Galicia.[13] The new program offers benefits to producers of up to 40% to total fixed capital corresponding to new investments; compulsory land expropriation; and reduction of up to 95% of the general tax on property transfers, turnover taxes, custom duties, and compensatory tax levied on new capital goods and equipment not manufactured locally. The benefits are granted for a 5-year period and may be extended.

Eastern Europe.—The Council for Mutual Economic Assistance (CMEA), of the Permanent Commission for the Iron and Steel Industry, celebrated its 25th anniversary in 1974. The Permanent Commission was formed to foster Socialist economic integration of CMEA member countries, the U.S.S.R., Czechoslovakia, Romania, Poland, East Germany, Hungary, Bulgaria, and Cuba. Yugoslavia cooperates with the member countries. Member countries signed general agreements on comprehensive cooperation in construction of a plant in the U.S.S.R. for the production of ferruginous raw materials and various types of ferroalloys. The plant will enable the U.S.S.R. to supply member countries with these products over a long period of time.

The Permanent Commission was in the process of organizing scientific and technical cooperation among the CMEA member countries and Yugoslavia on conservation and improvement of the environment and on rational utilization of natural resources. In related actions CMEA established a computerized information center at its headquarters in Moscow. The center will consist of a computer complex and nine laboratories that will be connected with the scientific/technical information systems of all CMEA countries. One of its first projects will be to establish an international system for translation of industrial catalogs and establishment of an information data bank on agricultural machinery and tractor production. One of the principal functions will be to coordinate activities and prevent duplication of ferrous metallurgy research.

The CMEA countries and Yugoslavia agreed on scientific technical cooperation in direct recovery of iron from ore and established a coordinating center for the research in Romania.

U.S.S.R.—The U.S.S.R. displaced the United States as the world's leading steel producer, producing 149,914,000 tons of raw steel in 1974, exceeding their previous record of 1973 by 3%. The Russians claimed the world's largest blast furnace with a working volume of 5,000 cubic meters and a capacity of 4 million tons of iron per year at Krivoy Rog in the Ukraine. It supplants the previous largest furnace, in the U.S.S.R. at Lipetsk, which was lit in February 1973. According to reports the Krivoy Rog plant is highly automated with smelting controlled by computer. Raw materials are supplied to the furnace by two belt conveyors, each approximately 1,500 meters in length.[14]

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[12] U.S. Embassy, Vienna, Austria. State Department Airgram A-95, Mar. 10, 1975, 3 pp.

[13] U.S. Embassy, Madrid, Spain. GOS Decree Establishes National Iron and Steel Plan. State Department Airgram A-90, Apr. 25, 1974, 3 pp.

The U.S.S.R. entered an agreement with a consortium of West German concerns, Salzgitter AG, Korf-Stahl AG, and Fried. Krupp Hüttenwerke AG, for the first stage of construction of a direct-reduction and associated steelworks plant in the Kursk Basin of Central U.S.S.R. The U.S.S.R. agreed to pay cash for the first stage, but Soviet officials made it clear that this method of financing does not set a precedent.[15]

AFRICA

Egypt, Arab Republic of.—The Egyptians produced 298,000 tons of raw steel in 1974, slightly more than they produced in 1973. Apparently the new facilities at the Helwan iron and steel complex being installed with the help of the U.S.S.R. did not operate during the year. Entrepreneurs from Japan, West Germany, and Brazil agreed to the construction of a sponge iron conversion plant in Alexandria. The Egyptian Government will participate in the company 50%, Japan 25%, West Germany 15%, and Brazil 10%. The project is to be capitalized at an estimated $150 million, of which as much as $80 million could be in U.S. goods and services.[16]

South Africa, Republic of.—The iron and steel industry of South Africa operated at capacity throughout 1974 to produce a record 6,356,000 tons of raw steel. The industry apparently was on the threshold of a major expansion program which could double its capacity by 1980. The principal problem seemed to be locating sufficient funds to finance the program.[17]

Representatives of employers and of 10 trade unions, representing about 70,000 white, colored, and Indian workers (plus the Chairman of Central Bantu Labor Board, speaking for about 280,000 unorganized blacks) negotiated a new industry-wide wage agreement in context of the National Industrial Council for Iron-Steel Engineering and Metallurgical Industry. The agreement raises the minimum wage for blacks from R64.00 to R78.00 per month ($94.14 to $114.74), and the minimum wage for artisans from R1.41 to R1.61 per hour ($2.07 to $2.37). The agreement was negotiated more than 6 months in advance of the time when the existing agreement was to expire.[18]

The Government-controlled South African Iron and Steel Industrial Corp. Ltd. (ISCOR) began producing steel at its new works at Newcastle early in March.[19] Highveld Steel and Vanadium Corp. Ltd. at Witbank was installing a four-strand caster for casting 100- to 140-millimeter billets.

ASIA

Most Asian countries except Japan and India produced more steel in 1974 than in 1973. In the aggregate they produced 175 million tons of raw steel in 1974 compared with 174 million tons produced in 1973.

China, People's Republic of.—China's steel industry produced a record 30 million tons of steel in 1974 but still fell far short of the potential demand. The Chinese negotiated with the Japanese and a consortium of 16 West German firms plus 1 Belgian firm and 1 Austrian firm to provide facilities for a hot and cold rolling mill at Whuhan.[20]

India.—The Indian iron and steel industry produced slightly less steel in 1974 than it did in 1973. The industry continued to be plagued by shortages of power, coke and coal, coke oven gas, and lack of coordinated planning. It was significant that although there was an acute shortage of steel in several different categories and India imported substantial quantities of high-value flat steel products, it exported low-value bars and rods. Most of the exports went to oil-producing Near Eastern countries. The Indian Government announced plans to export $125 million worth of iron and steel bars and rods during the 1974 fiscal year, April 1974 to March 1975.

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[14] Iron and Steel Engineer. World's Largest Blast Furnace. V. 52, No. 3, March 1975, p. 79.

[15] U.S. Embassy, Bonn, West Germany. State Department Airgram A-231, May 9, 1974, 5 pp.

[16] U.S. Embassy, Cairo, Egypt. State Department Airgram A-108, Aug. 21, 1974, 2 pp.

[17] U.S. Embassy, Pretoria, Republic of South Africa. State Department Airgram A-175, July 25, 1974, 7 pp.

[18] U.S. Consulate, Johannesburg, Republic of South Africa. State Department Telegram 604, June 18, 1974.

[19] U.S. Bureau of Mines. Iron and Steel: Republic of South Africa. Mineral Trade Notes, v. 71, No. 6, June 1974, p. 11.

[20] U.S. Consulate, Dusseldorf, West Germany. State Department Airgram A-34, Apr. 5, 1974, 1 p.

The first Linz Donawitz converter (BOF) at the Bokaro steel project in Bihar was formally inaugurated January 31, 1974. The new converter was the largest operated in India in 1974.[21]

Indonesia.—Swindell-Dressler Co., a division of Pullman, Inc., of the United States, announced that its contract with Ferrosteel A.G., a division of GHH of Essen, West Germany, to build an HyL direct reduction plant in Indonesia had been increased from $20 million to $80 million. The original contract was for a one-half-million-ton-per-year plant for P. T. Krakatau-Ferrosteel, at Kota Baja, West Java. The HyL plants will be part of a steel mill complex owned jointly by P. T. Krakatau and Ferrosteel A. G.[22]

Iran.—The Iranian Government continued actively to promote a domestic steel industry. Late in 1973, the Shah announced publicly a national goal of 15 million tons of steel production within 10 years. Contracts to build two more natural gas reduction plants brought the total commitment through 1974 to about 8 million tons of iron and steel capacity. A contract for construction of a million-ton-capacity gas reduction plant using the HyL process, was made with the Swindell-Dressler Corp. of the United States, and a contract for a 330,000-ton sponge plant using the Purofer method was signed with the Thyssen A.G. company of West Germany. The Purofer plant is to be at Ahwaz, site of the Korf Midland-Ross process plant, and the HyL plant may be built at Bandar-Abbas.[23]

Japan.—After more than 2 decades of unusual economic growth during which the gross national product rose at annual rates of up to 15%, the Japanese economy entered its most severe postwar slump. The Japanese steel industry was not as depressed as the overall economy, but it did not produce as much steel in 1974 as it did in 1973 despite exporting 36.5 million tons, 30% more than in 1973. The industry produced 129 million tons of steel; 115 million tons of the total was ordinary carbon steel and 14.5 million tons was special alloy steels; 104 million tons was produced in basic oxygen furnaces; 23 million tons in electric furnaces, and only 1.7 million tons in open hearths. Thus, basic oxygen furnaces (BOF) accounted for 81% of the total, electric furnaces 18%, and open hearth only 1%.

Japanese steel consumption, measured by domestic orders, totaled 68 million tons in 1974, 13% less than in 1973. The construction industry was the largest user with 60 million tons, 21% less than in 1973; the automobile industry used 7 million tons, 8% less than in 1973; and the shipbuilding industry used 8 million tons, 11% more than it used in 1973.

The Japanese Ministry of International Trade and Industry (MITI) assisted 23 steelmaking companies in forming a company to treat the dusts produced at their respective plants. The 23 companies discharge about 50,000 tons a year of recoverable dusts which contain 35% iron and 25% zinc.

The No. 5 blast furnace at the Fukuyama Works at Nippon Kokan KK produced a record 348,880 short tons of pig iron in April. The No. 5 furnace was lit in November 1973.

The experimental operations metallurgist of Nippon Kokan KK injected reducing gas directly into the stack of a blast furnace. Gas injection into the stack permitted equivalent reduction in blasts through the tuyeres, thereby permitting reduction in the size of blowers and hot stoves, as well as improving permeability in the melting zone.[24]

The Nuclear Steelmaking Technical Research Association started research on direct reduction processes in a shaft kiln at Hirohata Works of Nippon Steel Corp.[25]

OCEANIA

Australia.—The Australian steel industry produced 8.5 million tons of raw steel in 1974, slightly more than the 1973 record. Demand for steel continued strong throughout most of the year.

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[21] U.S. Consulate, Calcutta, India. State Department Airgram A-6, Feb. 5, 1974, 2 pp.

[22] American Metal Market. S-D's Ferrosteel Pact To Be Raised. V. 81, No. 133, July 10, 1974, p. 4.

[23] U.S. Embassy, Tehran, Iran. State Department Airgram A-080, May 19, 1974, 6 pp.

[24] Journal of Metals. Nippon Kokan KK Tries Reducing Gas Injection in Blast Furnace. V. 26, No. 5, May 1974, p. 4.

[25] Journal of Metals. Joint Study on the Direct Reduction Process To Be Instituted by the Steel Industry. V. 26, No. 1, January 1974, p. 4.

An international consortium of 13 private companies led by Australia's only steel producer, The Broken Hill Pty. Co. Ltd. (BHP), began a feasibility study to determine if it would be practical to build a large steel mill in Western Australia. Membership in the consortium was as follows: Australia: The Broken Hill Pty. Co. Ltd., and Pilbara Iron Ltd. (subsidiary of Colonial Sugar Refining Co. Ltd.); Japan: Nippon Steel Corp., Sumitomo Metal Mining Co. Ltd., Kawasaki Steel Corp., Kobe Steel Works, Ltd., and Nippon Kokan Co.; United States: AMAX, Inc., Jones & Laughlin Steel Corp., and National Steel Corp.; the United Kingdom: Guest Keen & Nettlefords, Limited, and British Steel Corp.; the Netherlands: Hoogovens IJmuiden Bv. A 10-million-ton semifinished steel plant was under consideration. Inasmuch as all members of the consortium are steel producers and/or users, the proposed plant could have an assured market.[26]

A joint Federal-State Government report entitled "The Pilbara Study" was released. The study was undertaken to determine if a steelworks, aluminum smelter, uranium enrichment plant, and a liquefied natural gas plant based on northwest shelf natural gas would be economically feasible.[27] The report contained 12 volumes of appendices and a 600-page summary. The summary was released to the public, but the 12 volumes of data were to be retained by the two governments for reference. Small, medium, and large industries in various combinations and/or complexes were considered. Estimated costs range from $4 million to more than $11 million. The report was not conclusive.

TECHNOLOGY

Most industrial research was designed to refine and perfect the new operating techniques and processes introduced in the last decade. Researchers looked for ways to improve continuous casting operations and oxygen steelmaking furnaces and ways to produce a wider variety of steels in the oxygen furnaces. There was the perennial search for better refining techniques and improved alloy steels, particularly the high-strength, low-alloy steels. A great deal of research was done on environmental controls, and studies were made on ways to use the variety of materials recovered from the effluents of steelmaking operations.

Conservation and development of new sources of energy was of great concern to the steel industry throughout the world. At the International Iron and Steel Institute's eighth annual conference, waste gas utilization, blast furnace fuel injection, coal gasification, and possible use of nuclear energy were among the subjects discussed.[28] An ad hoc working group on energy was formed to coordinate all activities relating to energy matters to avoid duplication and organize the work within a common framework.

The high cost of fuel oil and natural gas in some localities forced steel mills to discontinue use of these materials as blast furnace supplementary fuels. Substantial quantities of energy were saved by better housekeeping methods: Turning off lights, reducing the temperature in offices, cutting back on air-conditioning, and better maintenance of furnaces and steam lines.

Inland Steel Co. developed a linear programing model as a tool to obtain optimum use of energy at minimum cost at its Indiana Harbor works.[29] The model has been used to predict fuel and power requirements and costs for long-range plans involving major expansion projects in processing and finishing mills.

The No. 5 blast furnace at Fukuyama Works of Nippon Kokan in Japan, the world's largest blast furnace, produced 342,946 tons of hot metal in August, a record average of 11,063 tons per day.[30]

Top gas expansion turbine generators were installed at several blast furnace plants to conserve energy. This technique for conserving energy has been known for many years, but the capital expense of installing such equipment was not justified until the energy shortage more than doubled energy costs.

Development of direct reduction as a viable process for making steel accelerated in 1974. Bureau of Mines analysts counted 16 plants with a total annual capacity of 4,700,000 short tons operating profitably in midyear. Another 28 plants, with an estimated annual capacity of 12 million tons were in various stages of construction far enough advanced so that completion of all within the next 3 years was a practical certainty. Although seven direct reduction processes have been proved technically feasible and economically profitable in the last 5 years, they have not yet been operated for a long enough time in similar physical and economic environments to make a meaningful comparison of their merits. However, the existing high-iron briquet plant in Venezuela, and the planned Fior, Midrex, and HyL plants will facilitate comparison of the technical aspects of four processes, all of which were favorably regarded in 1974.

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[26] U.S. Consulate, Perth, Australia. State Department Airgram A-37, Oct. 1, 1974, 6 pp.

[27] U.S. Consulate, Perth, Australia State Department Airgram A-44, Nov. 25, 1974, 6 pp.

[28] 33 Magazine. The Energy Issue: A Giant Question Mark for Steel. V. 12, No. 12, December 1974, pp. 46–51.

[29] Gray, W. R., J. D. Fekete, and M. I. Tarcoff. A Steel Plant Energy Model. Iron and Steel Engineer, v. 51, No. 11, November 1974, pp. 54–59.

[30] Japan Iron and Steel Exporters Association. Steel, Today and Tomorrow. No. 8, January–February 1975, p. 12.

Bureau of Mines Research.—Bureau of Mines researchers at the Albany Metallurgy Research Center investigated the possibility of converting prereduced iron ore directly into homogenous workable steel with simple shapes. The objective of their work is to extend the usefulness of the electroslag melting process. This research also involves use of consumable electrodes of compacted prereduced iron ore pellets.

Bureau metallurgists at the Rolla Metallurgy Research Center continued their studies on developing methods for recovering valuable alloying metals from stainless, ferroalloy, and specialty steel wastes. The technical feasibility of recovering wastes such as flue dust, grinding swarf, and mill scale was demonstrated, and the economic feasibility of the processes was being investigated. Researchers at the Twin Cities Metallurgy Research Center continued studies on recovering and conserving thermal energy and increasing utilization of scrap in basic oxygen steelmaking operations. This project is entering the pilot plant stage to determine the technologic and economic parameters.

Table 2.—Pig iron produced and shipped in the United States, in 1974, by State

(Thousand short tons and thousand dollars)

State	Production	Shipped from furnaces		Average value per ton
		Quantity	Value	
Alabama	8,874	8,904	548,129	$140.40
Illinois	7,184	7,211	1,003,573	139.17
Indiana	17,001	17,022	1,991,438	116.99
Ohio	17,464	17,632	2,758,733	156.46
Pennsylvania	21,695	21,777	2,577,311	118.35
California, Colorado, Utah	5,094	5,104	536,878	105.18
Kentucky, Maryland, Texas, West Virginia	10,882	10,928	1,338,256	122.46
Michigan	7,612	7,612	1,069,227	140.47
New York	4,671	4,751	590,599	124.31
Total	95,477	95,941	12,414,144	129.39

Table 3.—Foreign iron ore and manganiferous iron ore consumed in manufacturing pig iron in the United States, by source of ore

(Thousand short tons)

Source	1973 [1]	1974 [2]
Australia	550	656
Brazil	r 1,396	3,971
Canada	r 1,909	1,111
Chile	r 649	253
Venezuela	5,707	5,629
Other countries	1,609	1,659
Total	r 11,820	13,279

r Revised.

[1] Excludes 21,573 tons used in making agglomerates.

[2] Excludes 20,952 tons used in making agglomerates.

Table 4.—Pig iron shipped from blast furnaces in the United States by grade [1]

(Thousand short tons and thousand dollars)

Grade	1973			1974		
		Value			Value	
	Quantity	Total	Average per ton	Quantity	Total	Average per ton
Foundry	6,785	465,367	$68.59	7,469	899,580	$120.44
Basic	[r] 90,577	6,771,346	[r] 74.76	85,376	11,136,633	130.44
Bessemer	1,321	97,308	73.66	1,130	135,510	119.92
Low-phosphorus	[r] 149	11,497	[r] 77.16	112	15,816	141.21
Malleable	2,349	[r] 181,625	77.32	1,408	175,413	124.58
All other (not ferroalloys)	447	36,549	81.77	446	51,192	114.78
Total	[r] 101,628	[r] 7,563,692	[r] 74.43	95,941	12,414,144	129.39

[r] Revised.

[1] Includes pig iron transferred directly to steel furnaces at same site.

Table 5.—Number of blast furnaces (including ferroalloy blast furnaces) in the United States, by State

State	Jan. 1, 1974			Jan. 1, 1975		
	In blast	Out of blast	Total	In blast	Out of blast	Total
Alabama	8	3	11	7	2	9
California	4	--	4	3	1	4
Colorado	4	--	4	4	--	4
Illinois	14	5	19	10	9	19
Indiana	25	1	26	21	6	27
Kentucky	2	--	2	2	--	2
Maryland	10	--	10	4	6	10
Michigan	9	--	9	9	--	9
Minnesota	--	2	2	--	2	2
New York	10	3	13	7	4	11
Ohio	31	11	42	27	14	41
Pennsylvania	36	17	53	34	16	50
Texas	2	--	2	2	--	2
Utah	3	--	3	2	1	3
West Virginia	4	--	4	3	1	4
Total	162	42	204	135	62	197
Ferroalloy blast furnaces	1	1	2	1	1	2
Grand total	163	43	206	136	63	199

Source: American Iron and Steel Institute.

Table 6.—Iron ore and other metallic materials, coke and fluxes consumed, and pig iron produced in the United States, by State

(Thousand short tons)

State	Metalliferous materials consumed							Net coke	Fluxes	Pig iron produced	Metalliferous materials consumed per ton of pig iron made				Coke and fluxes consumed per ton of pig iron	
	Iron and manganiferous ores		Agglomerates	Net ores and agglomerates [1]	Net scrap [2]	Miscellaneous [3]	Net total				Net ores and agglomerates [1]	Net scrap [2]	Miscellaneous [3]	Total	Net coke	Fluxes
	Domestic	Foreign														
1973:																
Alabama	291	W	3,852	6,106	r 73	r 27	6,206	2,614	633	3,836	1.592	r 0.019	r 0.007	1.618	0.681	0.165
Illinois	W	W	11,421	12,529	306	329	13,163	4,515	1,148	7,919	1.582	.039	.042	1.662	.570	.145
Indiana	W	W	24,911	26,387	367	1,125	27,879	8,989	1,981	17,128	1.541	.021	.066	1.628	.525	.113
Michigan and Minnesota	487	29	11,980	12,369	250	417	13,035	4,621	1,081	8,006	1.545	.031	.052	1.628	.577	.135
New York	1,757	26	W	8,280	183	421	8,884	3,545	734	5,390	1.536	.034	.078	1.648	.658	.136
Ohio	4,352	1,880	22,001	27,528	r 802	1,613	r 29,944	r 11,640	3,849	18,405	1.496	.044	.088	1.627	r .632	.209
Pennsylvania	6,152	3,806	25,307	34,784	r 757	1,051	r 36,592	13,462	2,470	r 23,088	r 1.507	r .033	.046	r 1.585	r .583	r .107
California, Colorado, Utah	r 4,436	--	W	r 11,768	170	103	r 12,041	3,290	1,058	5,595	r 2.103	.030	.018	r 2.152	.588	.189
Maryland, West Virginia, Kentucky, Texas	386	r 3,004	r 15,518	r 18,348	230	755	r 19,338	7,390	1,664	11,951	r 1.535	.019	.063	r 1.618	.618	.139
Total	r 19,846	r 11,820	r 129,118	158,099	r 3,138	r 5,841	r 167,077	r 60,066	[4] 14,568	r 101,318	r 1.560	r .031	.058	r 1.649	r .593	.144
1974:																
Alabama	242	W	3,690	6,130	98	8	6,236	2,589	640	3,874	1.582	.025	.002	1.610	.668	.165
Illinois	W	W	10,438	11,369	231	301	11,902	4,253	999	7,184	1.583	.032	.042	1.657	.592	.139
Indiana	W	W	24,716	26,067	335	1,439	27,840	9,476	2,234	17,001	1.533	.020	.085	1.638	.557	.131
Michigan and Minnesota	364	22	11,205	11,485	365	364	12,214	4,408	1,000	7,612	1.509	.048	.048	1.605	.579	.131
New York	1,226	468	W	7,130	200	293	7,623	3,016	651	4,671	1.526	.043	.063	1.632	.646	.139
Ohio	4,266	1,544	21,055	26,271	721	1,212	28,204	11,327	3,730	17,464	1.504	.041	.069	1.615	.649	.214
Pennsylvania	4,662	4,942	24,223	33,723	968	1,009	35,700	13,033	2,916	21,695	1.554	.045	.047	1.646	.601	.134
California, Colorado, Utah	4,250	W	W	10,934	170	95	11,199	3,120	1,133	5,094	2.146	.033	.019	2.198	.612	.222
Maryland, West Virginia, Kentucky, Texas	388	3,621	13,813	17,195	219	598	18,011	6,725	1,572	10,882	1.580	.020	.055	1.655	.618	.144
Total	17,708	13,278	121,571	150,304	3,307	5,319	158,929	57,947	[5] 14,875	95,477	1.574	.035	.056	1.665	.607	.156

r Revised. W Withheld to avoid disclosing individual company confidential data; included with "Total."

[1] Net ores and agglomerates equal ore plus agglomerates plus flue dust used minus flue dust recovered.

[2] Excludes home scrap produced at blast furnaces.

[3] Does not include recycled material.

[4] Fluxes consisted of the following: r 7,539 limestone, r 6,558 dolomite, and 471 other fluxes excluding 5,490 limestone, 3,437 dolomite, and 155 other fluxes used in agglomerating production at or near steel plants and an unknown quantity used in making agglomerates at mines.

[5] Fluxes consisted of the following: 6,763 limestone, 7,592 dolomite, and 520 other fluxes excluding 5,256 limestone, 15 burnt lime, 3,844 dolomite, and 288 other fluxes used in agglomerating production at or near steel plants and an unknown quantity used in making agglomerates at mines.

Table 7.—Steel production in the United States, by type of furnace[1]

(Thousand short tons)

Year	Open hearth[2]	Basic oxygen converter	Electric	Total
1970	48,022	63,330	20,162	131,514
1971	35,559	63,943	20,941	120,443
1972	34,936	74,584	23,721	133,241
1973	39,780	83,260	27,759	150,799
1974	35,499	81,552	28,669	145,720

[1] Excludes castings produced by foundries not covered by AISI.
[2] Basic and acid open-hearth production data reported separately in previous years.

Source: American Iron and Steel Institute.

Table 8.—Metalliferous materials consumed in steel furnaces[1] in the United States

(Thousand short tons)

Year	Iron ore		Agglomerates		Pig iron	Ferro-alloys[2]	Iron and steel scrap
	Domestic	Foreign	Domestic	Foreign			
1970	502	1,889	465	476	81,797	1,641	66,451
1971	308	1,166	294	320	76,422	1,447	63,308
1972	236	850	401	192	88,569	1,655	68,345
1973	163	1,320	656	243	r 94,883	1,907	83,228
1974	153	1,126	272	302	90,341	1,950	83,249

r Revised.
[1] Basic oxygen converter, open-hearth, and electric furnace.
[2] Includes ferromanganese, spiegeleisen, silicomanganese, manganese metal, ferrosilicon, ferrochromium alloys, and ferromolybdenum.

Table 9.—Consumption of pig iron[1] in the United States, by type of furnace

Type of furnace or equipment	1972		1973		1974	
	Thousand short tons	Percent of total	Thousand short tons	Percent of total	Thousand short tons	Percent of total
Basic oxygen converter	60,233	69.9	r 68,027	69.7	66,614	71.5
Open hearth	22,375	25.9	25,477	26.1	22,507	24.2
Electric	961	1.1	1,379	1.4	1,220	1.3
Cupola	2,264	2.6	2,276	2.3	2,123	2.3
Air	139	.2	57	.1	(2)	(2)
Other furnaces[3]	254	.3	402	.4	632	.7
Total	86,226	100.0	r 97,618	100.0	93,096	100.0

r Revised.
[1] Excludes molten pig iron used for ingot molds and direct castings.
[2] Included with "Other furnaces."
[3] Includes vacuum melting furnaces and miscellaneuos melting processes.

Table 10.—Consumption of pig iron[1] in the United States, by State
(Thousand short tons)

State	1974
Arkansas	8
Arizona	([2])
Connecticut	14
Delaware	([2])
Florida	2
Georgia	3
Illinois	7,281
Indiana	17,182
Iowa	29
Louisiana	([2])
Maine	([2])
Massachusetts	32
Michigan	7,906
Minnesota	44
Nebraska	([2])
Nevada	([2])
New York	4,438
North Carolina	11
Ohio	17,262
Oklahoma	5
Pennsylvania	22,481
Rhode Island	3
Tennessee	97
Texas	1,375
Wisconsin	130
Undistributed[3]	18,487
Total	96,790

[1] Includes molten pig iron used for ingot molds and direct castings.

[2] Less than ½ unit.

[3] Includes Alabama, California, Colorado, Kansas, Kentucky, Maryland, Missouri, New Hampshire, New Jersey, Oregon, South Carolina, Utah, Vermont, Virginia, Washington, and West Virginia.

Table 11.—U.S. exports of major iron and steel products

Products	1970 Quantity (short tons)	1970 Value (thousands)	1971 Quantity (short tons)	1971 Value (thousands)	1972 Quantity (short tons)	1972 Value (thousands)	1973 Quantity (short tons)	1973 Value (thousands)	1974 Quantity (short tons)	1974 Value (thousands)
SEMIMANUFACTURED										
Ingots and other primary forms:										
Puddled bars and pilings, blocks, lump and other primary forms of iron or steel, n.e.c	11,425	$1,721	1,916	$291	543	$107	38	$18	1,228	$653
Blooms, billets, ingots, slabs, sheet bars, and roughly forged pieces	3,169,563	270,368	873,526	78,191	415,392	37,860	546,991	63,023	804,767	147,731
Coils for rerolling	340,630	49,903	14,347	7,646	85,473	13,816	43,702	10,732	149,643	38,760
Blanks for tubes and pipes, iron or steel	2,175	280	2,334	271	2,807	311	3,787	394	2,654	420
Total	3,523,793	322,272	892,123	86,399	504,215	52,094	594,468	74,167	958,287	187,564
Bars, rods, angles, shapes and sections:										
Wire rods	151,062	18,541	62,843	8,415	122,894	16,169	89,786	15,303	65,847	17,469
Bars, rods, and hollow-drill steel	216,362	48,415	129,872	38,550	166,794	43,735	239,617	70,368	415,955	147,443
Concrete reinforcing bars	92,534	12,134	40,540	6,089	22,417	3,141	151,585	29,788	320,272	86,036
Angles, shapes, and sections	212,405	37,554	164,031	33,111	124,825	25,756	272,519	58,708	397,560	109,130
Plates and sheets:										
Steel plates	27,011	14,021	23,353	12,062	15,063	10,262	29,392	17,405	54,791	32,204
Steel sheets	1,268,886	190,079	583,015	82,982	396,860	66,679	658,430	152,935	1,014,410	290,050
Black plate	67,931	9,133	85,202	13,527	58,831	8,880	95,272	16,344	81,297	18,708
Iron and steel plates, n.e.c	292,803	56,835	161,921	37,492	198,653	42,184	473,911	97,176	536,337	166,602
Tinplate and terneplate	341,275	61,844	224,120	43,101	290,255	55,272	419,275	95,344	500,939	173,742
Tinplate circles, cobbles, strip and scroll	28,910	2,628	9,716	1,186	4,565	552	24,151	2,678	17,395	2,654
Hoop and strip	376,068	73,311	129,128	42,619	404,211	76,146	268,762	83,076	394,738	141,894
Total	3,069,747	524,495	1,613,741	319,134	1,805,368	348,726	2,722,650	639,125	3,799,541	1,185,932
MANUFACTURED										
Rails and railway track construction materials:										
Rails	63,980	10,143	50,291	8,489	105,396	16,042	108,965	19,184	128,631	26,221
Joints and tie plates	7,976	1,620	8,948	2,563	9,348	2,173	14,302	3,667	34,610	9,301
Sleeper and track material of iron or steel, n.e.c	9,873	4,104	4,599	2,073	4,767	2,231	4,253	2,044	10,002	5,096
Wire, cables, ropes, bands, and slings	72,868	38,479	62,746	38,282	69,819	43,581	88,469	58,639	123,704	97,001
Tubes, pipes, and fittings:										
Cast-iron pressure pipe and fittings	22,034	8,173	15,481	8,095	32,586	11,399	27,897	13,575	38,857	29,244
Cast-iron soil pipe and fittings	11,537	3,690	8,288	2,813	4,797	1,744	6,208	2,894	13,358	8,496
Steel tube and pipe fittings, unions, and flanges	22,262	33,214	21,707	36,679	17,517	32,001	21,451	40,176	32,055	68,698
Steel tube and pipe fittings, welded	12,840	19,469	10,546	18,306	7,155	14,082	7,621	15,186	12,304	27,668

Malleable iron tube and pipe fittings, n.e.c	1,560	1,857	2,407	2,764	2,282	2,688	3,747	5,449	4,104	5,907
Electrical conduit fittings of iron or steel	10,458	7,971	7,289	8,880	3,907	5,646	4,611	6,710	7,006	10,911
Iron tube and pipe fittings n.e.c	7,935	10,414	7,820	12,068	8,394	14,535	11,315	20,827	14,150	30,986
Seamless tubes and pipe	243,835	100,295	222,768	99,542	236,633	104,810	376,997	162,263	628,082	513,862
Welded, clinched or riveted tubes and pipe	100,721	40,579	111,564	44,709	187,548	60,504	207,893	77,658	268,353	156,551
Finished structural iron and steel	142,462	67,727	117,275	63,028	89,620	77,989	219,228	153,914	294,350	251,688
Castings and forgings	255,671	102,726	295,619	114,320	371,888	129,629	439,298	173,576	481,091	230,540
Storage tanks, lined or unlined	16,589	11,174	15,582	10,494	14,885	9,628	14,804	11,764	29,826	25,153
Nails, tacks, staples, and spikes, n.e.c	7,667	6,499	7,720	5,835	9,045	7,364	12,822	10,928	16,172	14,358
Bolts	26,069	23,634	23,837	23,348	26,062	24,962	31,394	31,677	38,851	44,287
Nuts	5,846	8,684	5,780	9,374	8,845	11,822	10,865	14,613	15,901	22,536
Screws, rivets, washers	21,271	27,622	19,939	27,342	26,401	33,270	32,272	42,850	38,880	58,194
Total	1,063,399	528,074	1,020,206	538,994	1,236,897	605,600	1,644,412	867,594	2,230,287	1,636,698
Grand total	7,656,939	1,374,841	8,526,070	944,527	3,546,480	1,006,420	4,961,530	1,580,886	6,988,115	3,010,194

Table 12.—U.S. imports for consumption of pig iron, by country

Country	1972		1973		1974	
	Quantity (short tons)	Value (thousands)	Quantity (short tons)	Value (thousands)	Quantity (short tons)	Value (thousands)
Algeria	--	--	--	--	6,079	$1,381
Australia	--	--	--	--	1,449	184
Brazil	212,590	$8,044	57,634	$2,726	--	--
Canada	415,293	25,068	387,168	26,132	288,955	32,568
Colombia	--	--	--	--	7,752	966
Czechoslovakia	--	--	--	--	395	9
Finland	--	--	--	--	142	28
Germany, West	--	--	62	4	--	--
Guyana	--	--	154	10	--	--
Hungary	--	--	--	--	17,367	2,733
Japan	61	2	--	--	--	--
South Africa, Republic of	8,987	403	39	2	--	--
Sweden	--	--	569	51	8,298	989
United Kingdom	1	1	--	--	11,911	2,180
Total	636,932	33,518	445,626	28,925	342,348	41,038

Table 13.— U.S. imports for consumption of major iron and steel products

Products	1970		1971		1972		1973		1974	
	Quantity (short tons)	Value (thousands)	Quantity (short tons)	Value (thousands)	Quantity (short tons)	Value (thousands)	Quantity (short tons)	Value (thousands)	Quantity (short tons)	Value (thousands)
Iron products:										
Cast iron pipes and tubes	18,491	$5,534	12,356	$2,516	11,870	$3,923	6,248	$1,878	6,593	$3,053
Malleable cast-iron fittings	9,690	4,229	11,962	6,164	13,777	7,668	8,493	6,018	6,643	5,765
Bars of wrought iron	428	123	226	65	386	120	243	84	390	139
Castings and forgings	15,819	5,446	12,975	5,219	15,395	6,447	23,059	11,138	35,898	20,371
Total	44,428	15,332	37,519	13,964	41,428	18,158	38,043	19,113	49,524	29,328
Iron and steel products:										
Ingots, blooms, billets, slabs, and sheet bars	170,647	29,917	274,407	37,191	261,694	38,242	172,305	30,801	182,859	42,839
Bars of steel:										
Concrete reinforcement bars	202,699	21,200	514,813	49,809	358,223	34,969	286,428	48,875	477,750	137,286
Solid and hollow steel bars	727,742	115,027	1,027,768	153,831	1,049,173	176,744	954,286	197,426	866,458	301,733
Hollow drill steel	4,212	1,687	2,392	1,088	4,606	1,285	2,637	1,376	2,929	1,819
Plates and sheets:										
Black plate	5,753	987	7,452	1,371	2,010	438	3,323	651	8,333	2,352
Steel plate	968,677	124,109	1,572,560	198,952	1,685,654	239,412	1,348,767	216,255	1,729,001	499,862
Steel sheets	5,271,943	710,623	7,746,578	1,069,372	6,959,182	1,043,449	5,837,588	986,676	5,689,737	1,621,105
Plates and sheets of iron or steel	250	404	417	550	532	441	709	549	527	350
Plates, sheets and strip of iron or steel[1]	50,968	10,100	75,970	14,255	64,179	13,945	71,787	16,976	61,407	21,249
Strip of iron or steel	92,335	37,934	114,902	43,678	135,400	51,850	116,415	52,306	98,058	60,834
Tinplate and terneplate	327,725	59,066	417,691	80,595	522,466	107,870	470,345	105,630	318,996	98,349
Structural iron and steel	1,300,847	186,385	1,637,154	231,060	1,745,696	247,426	1,375,223	228,419	1,229,375	358,640
Angles, shapes, and sections	416,124	50,030	550,350	61,971	562,864	65,598	457,457	63,044	521,622	156,371
Wire rods of steel	1,055,570	131,810	1,538,288	187,607	1,402,904	188,789	r 1,416,256	229,258	1,950,628	581,611
Sheet piling	52,335	6,189	89,208	10,605	94,781	12,909	81,248	12,303	84,162	19,295
Pipes, tubes and fittings	1,976,749	341,441	1,888,942	340,425	1,887,376	368,846	1,681,112	383,372	1,952,522	748,934
Bail ties of iron or steel	15,353	2,279	21,047	3,307	17,166	3,067	15,334	3,011	27,452	9,530
Steel castings and forgings	14,039	6,660	12,958	5,275	24,000	9,186	19,020	7,137	13,555	8,358
Rails and railway track construction materials	72,306	11,328	68,863	11,084	74,820	12,350	77,697	14,741	117,478	34,025
Wire:										
Round wire	505,164	116,561	530,194	125,722	522,205	138,618	525,893	173,701	608,888	317,362
Other wire	143,726	33,875	135,737	33,464	155,770	43,807	87,740	32,217	93,538	55,230
Nails	259,833	52,522	308,105	60,428	379,912	86,572	345,121	97,332	355,815	167,201
Total	13,634,992	2,050,129	18,535,791	2,721,590	17,910,613	2,885,818	r 15,346,641	2,897,056	16,391,090	5,244,335
Advanced manufactures:										
Bolts, nuts, rivets and washers	181,559	73,718	170,966	67,235	206,428	88,259	223,192	129,043	305,418	309,044
Grand total	13,860,979	2,139,179	18,744,276	2,802,789	18,158,469	2,992,230	r 15,607,876	3,045,212	16,746,032	5,582,707

r Revised.

[1] Includes plates, sheets and strips of iron or steel, electrolytically coated or plated; 1970, 35,610 tons ($5,802); 1971, 67,359 tons ($11,583); 1972, 58,681 tons ($11,797); 1973, 63,787 tons ($14,020); 1974, 48,945 tons ($14,957).

Table 14.—Pig iron:[1] World production by country

(Thousand short tons)

Country[2]	1972	1973	1974 p
North America:			
Canada	9,364	10,511	10,386
Mexico[3]	2,948	3,059	3,535
United States	88,876	101,317	95,477
South America:			
Argentina	936	886	1,176
Brazil	5,842	6,037	6,444
Chile	r 537	505	569
Colombia[4]	318	291	264
Peru[4]	180	279	336
Venezuela[4]	591	602	601
Europe:			
Austria	3,137	3,313	3,795
Belgium	r 12,976	13,951	14,352
Bulgaria	1,673	1,726	1,635
Czechoslovakia[5]	r 9,184	9,407	9,816
Denmark	r 219	84	--
Finland	1,305	1,557	1,522
France	20,449	21,781	24,235
Germany, East[6]	2,371	2,427	2,513
Germany, West[7]	34,930	40,191	43,853
Greece[8]	375	564	551
Hungary	2,253	2,301	e 2,510
Italy	10,378	11,059	12,881
Luxembourg[4]	5,149	5,610	6,027
Netherlands	4,728	5,188	5,296
Norway[8]	r 725	772	729
Poland	8,037	8,380	e 8,380
Portugal	r 394	427	402
Romania	5,390	6,297	6,676
Spain	6,528	6,913	7,591
Sweden[3]	2,792	3,041	3,500
Switzerland	31	29	e 39
U.S.S.R.	101,773	104,650	e 108,460
United Kingdom	r 16,715	18,385	15,318
Yugoslavia	r 2,005	2,155	2,344
Africa:			
Algeria	438	395	e 395
Egypt, Arab Republic of[6]	r 365	486	547
Morocco e	11	11	11
Rhodesia, Southern[4]	320	320	e 330
South Africa, Republic of	4,860	4,774	5,094
Tunisia	158	174	e 155
Asia:			
China, People's Republic of e [9]	29,000	31,000	36,000
India	7,944	8,276	7,296
Iran	e 600	441	1,653
Israel e	40	40	40
Japan	81,632	99,216	99,690
Korea, North e [9]	2,900	3,000	3,300
Korea, Republic of	[10]	501	1,088
Malaysia e	90	110	120
Taiwan	r 141	165	123
Thailand	13	16	e 17
Turkey	r 1,249	986	1,330
Oceania:			
Australia	r 7,155	8,441	7,992
New Zealand (all sponge iron) e	110	110	140
Total	r 500,135	552,157	566,534

e Estimate. p Preliminary. r Revised.

[1] Table excludes all ferroalloy production except where otherwise noted.

[2] In addition to the countries listed, North Vietnam and Zaire presumably have facilities to produce pig iron, but available information is inadequate to make reliable estimates of output levels.

[3] Includes sponge iron output as follows in thousand short tons: Mexico: 1972—865; 1973—831; 1974—e 990; Sweden: 1972—196; 1973—r 209; 1974—217.

[4] Includes ferroalloys, if any are produced.

[5] May include blast furnace ferroalloys for 1973 and 1974.

[6] May include ferroalloys.

[7] Includes blast furnace ferroalloys except ferromanganese, ferrosilicon and spiegeleisen.

[8] Includes blast furnace ferroalloys, if any are produced.

[9] Includes ferroalloy production.

[10] Revised to zero.

Table 15.—Raw steel:[1] World production by country

(Thousand short tons)

Country[2]	1972	1973	1974 [p]
North America:			
Canada	13,078	14,755	15,017
Cuba	206	[e] 220	[e] 220
Mexico	4,884	5,247	5,636
United States[3]	133,241	150,799	145,720
South America:			
Argentina	2,320	2,430	2,595
Brazil[4]	7,185	7,881	8,285
Chile	695	605	700
Colombia	412	374	343
Peru	200	392	531
Uruguay	14	13	16
Venezuela	1,243	1,172	1,147
Europe:			
Austria	4,486	4,672	5,179
Belgium	16,019	17,110	17,894
Bulgaria	2,338	2,476	2,412
Czechoslovakia	14,029	14,504	15,287
Denmark	[5] 549	[5] 499	590
Finland	1,605	1,780	1,825
France	26,515	27,849	29,788
Germany, East	6,250	6,493	6,790
Germany, West	48,177	54,587	58,678
Greece	667	830	675
Hungary	3,608	3,673	3,821
Ireland	85	128	123
Italy	21,842	23,143	26,238
Luxembourg	6,016	6,530	7,108
Netherlands	6,157	6,200	6,437
Norway	[r] 1,012	1,061	1,042
Poland	14,855	15,495	16,056
Portugal	[r] 475	506	415
Romania	8,158	8,996	9,810
Spain	[r] 10,511	11,915	12,410
Sweden	5,795	6,243	6,602
Switzerland	598	644	653
U.S.S.R	138,438	144,909	149,914
United Kingdom	27,912	29,375	24,723
Yugoslavia	2,853	2,950	3,122
Africa:			
Algeria	[r] 369	435	[e] 440
Egypt, Arab Republic of [e]	[r] 250	287	298
Morocco [e]	1	3	3
Rhodesia, Southern [e]	220	280	300
South Africa, Republic of	[r] 5,825	6,135	6,356
Tunisia	[r] 145	150	[e] 152
Uganda	12	17	18
Asia:			
Bangladesh	64	71	66
Burma [e]	[r] 17	22	22
China, People's Republic of	25,000	[e] 28,000	[e] 30,000
India	7,641	7,678	7,380
Iran	—	220	281
Israel [e]	[r] 100	120	130
Japan	106,814	131,530	129,115
Korea, North [e]	2,800	2,900	3,200
Korea, Republic of	645	1,276	2,133
Lebanon [e]	17	17	17
Malaysia [e]	90	110	120
Philippines [e]	276	276	276
Singapore	210	225	[e] 240
Taiwan	[r] 518	559	621
Thailand	201	[e] 210	243
Turkey	[r] 1,568	1,282	1,473
Oceania:			
Australia	7,433	8,470	8,548
New Zealand [e]	[r] 78	110	165
Total	[r] 692,712	766,839	779,349

[e] Estimate. [p] Preliminary. [r] Revised.

[1] Steel formed in first solid state after melting suitable for further processing or sale.

[2] In addition to the countries listed, North Vietnam produces raw steel, but information is inadequate to make reliable estimates of output levels.

[3] Data from American Iron and Steel Institute (AISI). Excludes steel produced by foundries not reporting output to AISI but reported to Bureau of Census as follows (in thousand tons): 1972—[r] 1,584; 1973—[r] 1,894; 1974—2,092.

[4] Ingots only.

[5] Apparently excludes shipyards' production of steel castings.

Iron and Steel Scrap

By D. H. Desy [1]

In compiling the annual scrap and pig iron statistics for 1974 (but not the monthly statistics as published in Mineral Industry Surveys), an augmented survey of iron and steel foundries was used. This resulted in apparent increases in scrap consumption of 3.4% for steel foundries, 16.3% for iron foundries and miscellaneous manufacturers, and 3.0% for the total of all types of manufacturers. (A comparison of the totals obtained from the previously used panel compared with those from the augmented panel, which will henceforth be used, is shown in tables 2 and 3.) Domestic consumption of iron and steel scrap in 1974 fell by 1.2%, compared with that of 1973, when both years are compared on the basis of the unaugmented survey. Continuing high domestic and foreign demand during the first half of 1974 influenced prices to rise to record highs, despite the imposition of export controls during the year.

Direct-reduced iron (prereduced iron) was utilized by a few steel companies for electric furnace steel production. Total consumption of direct-reduced iron in 1974 was 614,000 tons.

Research in recycling of ferrous waste materials continued in Bureau of Mines laboratories. Increasing amounts of ferrous waste were being made available by municipal recycling centers throughout the country.

Legislation and Government Programs.—Export controls on iron and steel scrap were imposed by the U.S. Department of Commerce throughout the year. Total export quotas of 2.1 million tons per quarter in 1974 were established at the beginning of each quarter. Of this amount, 100,000 tons was reserved for contingencies during the first quarter, and 150,000 tons for contingencies and 50,000 tons for vessels sold by the U.S. Maritime Administration for scrapping abroad for each of the last three quarters. Quotas on all grades of scrap iron and steel except stainless steel scrap were established for individual countries and for exporters according to historical patterns. During the fourth quarter, 480,000 tons of the total quota was set aside for licensing to exporters, without regard to their past history of exports, to provide increased opportunity for participation by all exporters. Export controls were removed December 31, 1974.

Effective February 15, 1974, the Cost of Living Council removed all phase IV price controls on ferrous scrap. These controls had applied to prompt industrial and processed obsolete ferrous scrap handled by firms with sales of more than $50 million per year and with more than 60 employees.

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[1] Physical scientist, Division of Ferrous Metals.

Table 1.—Salient iron and steel scrap and pig iron statistics in the United States
(Thousand short tons and thousand dollars)

	1973	1974
Stocks Dec. 31:		
Scrap at consumer plants	[r] 7,086	8,408
Pig iron at consumer and supplier plants	1,215	763
Total	[r] 8,301	9,171
Consumption:		
Scrap	[r] 103,606	105,483
Pig iron	[r] 99,821	96,792
Exports:		
Scrap (excludes rerolling material)	10,874	8,497
Value	$570,011	$823,720
Imports for consumption:		
Scrap (includes tinplate and terneplate scrap)	349	201
Value	$19,100	$27,027

[r] Revised.

AVAILABLE SUPPLY

The new supply of iron and steel scrap available for consumption at consumers' plants in 1974 was 106.6 million tons. It consisted of 55.3 million tons of home scrap and 51.3 million tons of purchased scrap (net receipts). Because of the change in the reporting panel, these figures cannot be directly compared with those for 1973.

CONSUMPTION

Consumption of iron and steel scrap in 1974 was 105.5 tons. Manufacturers of pig iron, steel ingots, and castings took 81.1 million tons, or 77% of the total. Iron foundries and miscellaneous users consumed 21.1 million tons, or 20%, and manufacturers of steel castings consumed the remainder. Because of the change in the reporting panel, these figures cannot be directly compared with those for 1973.

STOCKS

Consumers' stocks reported on hand as of December 31, 1974, were 8.4 million tons. Because of the change in the reporting panel, this figure cannot be directly compared with that for 1973.

PRICES

Prices for iron and steel scrap reached alltime records in 1974. The Iron Age composite price for No. 1 heavy melting scrap peaked at $144.50 per long ton on April 1, and the average monthly composite price attained its highest point at $127.60 per long ton in July. The average annual composite price for No. 1 heavy melting scrap was $108.52, 87% above the average price of $57.95 for 1973. Prices for other grades of scrap generally reached equivalently high levels. After July, prices generally declined, and the composite price for No. 1 heavy melting scrap was $76.83 per long ton at yearend.

FOREIGN TRADE

Exports of iron and steel scrap (excluding rerolling material, and ships, boats, and other vessels for scrapping) amounted to 8.5 million short tons in 1974, 22% less than the 10.9 million tons exported in 1973, reflecting the imposition of scrap export controls during 1974.

Japan was the largest importer of U.S. scrap, taking 35.1% of the total in 1974. The next largest importers were Canada, Spain, and Mexico, which received 11.1%, 10.5%, and 10.5%, respectively.

No. 1 heavy melting steel scrap continued as the largest export grade, accounting for 30% of the total. Next largest export grades were shredded steel scrap and No. 2 bundles, which accounted for 24% and 15%, respectively.

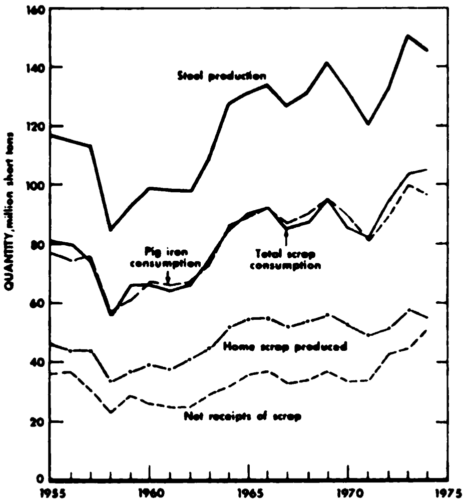

Figure 1.—Steel production (AISI), total iron and steel scrap consumption, pig iron consumption, home scrap production, and net scrap receipts.

WORLD REVIEW

Germany, West.—Demand for scrap remained high as steel production continued to break previous records. Raw steel production was 58.7 million tons, 7% over 1973 production. Total scrap consumption was 28.2 million tons, up 2% from 1973 consumption. Of this amount, 82.1% was used in steel production, 15.7% for gray and malleable iron castings, and 2.2% for pig iron production. Of the total scrap supply of 31.1 million tons, 47% consisted of home scrap, 39% was purchased scrap, and 14% was from other sources and stock adjustments.

India.—Demand for iron and steel scrap in India in 1974 was reportedly 20% below that of previous years, attributed to reduced electric furnace steel production. Between 1969 and 1974, consumption of scrap was less than 1 million tons annually, although the availability of scrap was estimated at about 2.5 million tons annually. Despite the apparent surplus, exports of scrap have been banned since 1969. Scrap processing capacity has remained at about 25% of scrap availability.

Japan.—Japan imported 2.98 million tons of iron and steel scrap from the United States in 1974, 36% less than in 1973, but owing to the higher price of scrap in 1974, the imports were valued at $305 million, compared with $234 million in 1973.

The Steel Scrap Stockpiling Company was formed by nine scrap cartels and will purchase domestic and imported scrap. The purposes are to stabilize the price and supply of scrap. Initially, 275,000 tons will be stockpiled, to be later increased to 1.1 million tons.

Sweden.—There was heavy demand for scrap throughout Scandinavia. The price of scrap in Sweden rose about 38% during the year. Between 60% and 65% of old cars in Sweden are now fragmentized at the Bilfrag plant in Halmstad. Swedish scrap imports for 1974 were estimated at 331,000 tons, mostly from the Soviet Union and Poland. This was a 15% increase over 1973 imports.

United Kingdom.—Exports of ferrous scrap from the United Kingdom in 1974 were 344,000 tons, down from 817,000 tons in 1973 as a result of restrictions on exports during 1974. For most of the year, exports were confined to European Community (EC) countries, and as a result, Spain, formerly the largest importer of United Kingdom scrap, received only 50,000 tons compared with 360,000 tons in 1973. Belgium-Luxembourg was the largest importer with 149,000 tons, and the EC as a whole received 291,000 tons, or 85% of the total. Total imports were 154,000 tons in 1974, down 37% from 245,000 tons in 1973. The transitional period for the United Kingdom's entry into the EC ended December 31, 1974.

TECHNOLOGY

Specialized scrap-handling equipment was increasingly employed by scrap processing firms. About 125 automobile shredders were operating by yearend. The total amount of shredded scrap consumed domestically or exported was 5.2 million tons, up 16% from the equivalent quantity in 1973. Other types of equipment included automobile flatteners, chip briquetters, and engine crushers.

Ferrous scrap was being reclaimed from recycling centers in Houston, Tex., Atlanta, Ga., San Francisco and Oakland, Calif., St. Louis, Mo., Madison, Wis., New Castle County, Del., and several other locations. In all, about 28 centers were operating or in the planning stage. Some of the recycling plant designs were based on the Bureau of Mines raw refuse recycling pilot plant at its College Park (Md.) Metallurgy Research Center.

Small quantities of direct-reduced iron were utilized by some steel plants as a substitute for scrap.

The Bureau of Mines continued its research program on the recycling of waste materials, including ferrous scrap. At the Bureau's Albany (Oreg.) Metallurgy Research Center, research was concluded on continuous charging of electric furnaces with preheated scrap, and mixtures of scrap with prereduced iron pellets. It was found that melting could be done with shorter heat times, lower energy consumption, and higher energy input. A project was also completed that demonstrated the feasibility of producing secondary pig iron from shredded auto scrap. This material would be a suitable substitute for blast furnace pig iron for making gray iron castings.[2] At the Bureau's Rolla (Mo.) Metallurgy Research Center, research was continued on the effects of contaminants such as copper, tin, lead, and chromium in ferrous scrap, originating from municipal waste, on the properties of ductile (nodular) cast iron. The results of studies on the effects of combined tin and copper in as-cast ductile iron were published.[3] Studies continued on the effect of heat treatment on the properties of ductile iron containing minor amounts of copper, tin, and chromium.

In another project at Rolla, chromium, nickel, iron, manganese, and molybdenum were reclaimed from electric furnace flue dusts, mill scale, and grinding swarf.[4] The dusts were pelletized together with a reducing agent and melted in an induction furnace to form an alloy containing 10% to 20% chromium, 6% to 12% nickel, and 55% to 65% iron, plus lesser amounts of manganese and molybdenum.

Metallurgists at the Bureau's Twin Cities (Minn.) Metallurgy Research Center developed a scrap preheating method that uses the hot waste gases generated by the basic oxygen steelmaking process.[5] The method saves up to 44% of the energy required to melt scrap when it is used as part of the charge of the basic oxygen furnace. As a result, the amount of scrap that can be used in this process can be raised from 30% to 40% of the charge.

Also at Twin Cities, it was demonstrated that combinations of automobile scrap and municipal refuse scrap can be successfully converted to gray cast iron in a cupola.[6] Aluminum, in the form of bimetallic cans from municipal refuse, was found to reduce sulfur levels and to improve furnace performance and recovery of silicon in the gray iron produced.

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[2] Tress, J. E., and W. L. Hunter. Secondary Pig Iron From Shredded Auto Scrap. BuMines RI 7808, 1973, 9 pp.

[3] Neumeier, L. A., B. A. Betts, and D. H. Desy. Tin and Copper Combinations in As-Cast Ductile Iron. AFS Trans., v. 82, 1974, pp. 131–138.

[4] Powell, H. E., W. M. Dressel, and R. L. Crosby. Experimental Metals Reclamation Process Recovers Alloys From Steel Mill Wastes. 33 Magazine, v. 13, No. 4, April 1975, pp. 48–50.

[5] Drost, J. J., C. B. Daellenbach, W. M. Mahan, and W. C. Hill. Thermal Energy Recovery by Basic Oxygen Furnace Offgas Preheating of Scrap. BuMines RI 7929, 1974, 8 pp.

[6] Daellenbach, C. B., W. M. Mahan, and J. J. Drost. Utilization of Automobile and Ferrous Refuse Scrap in Cupola Iron Production. Proc. 4th Mineral Waste Utilization Symp., sponsored by U.S. BuMines and IIT Res. Inst. Chicago, Ill., May 7–8, 1974, pp. 417–423.

Table 2.—U.S. consumer receipts, production, consumption, shipments and stocks of iron and steel scrap in 1974, by grade

(Thousand short tons)

Grade of scrap	Receipts of scrap: From brokers, dealers, and other outside sources	Receipts of scrap: From other own-company plants	Production of home scrap: Recirculating scrap resulting from current operations	Production of home scrap: Obsolete scrap (includes ingot molds and scrap from old equipment, obsolete buildings, etc.)	Consumption of both purchased and home scrap (includes recirculating scrap)	Shipments of scrap	Ending stocks Dec. 31
MANUFACTURERS OF PIG IRON AND STEEL INGOTS AND CASTINGS [1]							
Carbon steel:							
Low-phosphorus plate and punchings	728	5	22	2	761	3	91
Cut structural and plate	390	9	257	7	657	8	32
No. 1 heavy melting steel	8,347	2,289	20,084	229	28,274	2,354	2,296
No. 2 heavy melting steel	3,152	214	1,092	6	4,133	106	679
No. 1 and electric furnace bundles	6,774	493	2,668	20	9,656	103	863
No. 2 and all other bundles	3,404	173	467	--	3,656	135	554
Electric furnace 1 foot and under (not bundles)	145	5	66	--	133	--	9
Railroad rails	123	1	--	--	237	--	13
Turnings and borings	1,853	117	337	4	2,185	106	169
Slag scrap (Fe content 70%)	1,632	131	2,421	--	4,052	99	268
Shredded or fragmentized	2,177	318	--	--	2,332	1	215
All other carbon steel scrap	3,532	275	11,884	103	14,651	1,105	589
Stainless steel scrap	477	52	752	1	1,202	53	144
Alloy steel (except stainless)	222	194	1,988	13	2,313	80	220
Ingot mold scrap	449	578	1,110	1,803	3,628	662	368
Cast iron borings	504	429	997	109	1,726	303	87
Motor blocks	5	--	-	--	5	--	1
Other iron scrap	475	214	807	54	1,105	438	322
Other mixed scrap [2]	168	122	115	3	368	33	20
Total scrap [3]	34,560	5,620	45,068	2,353	81,074	5,589	6,940
MANUFACTURES OF STEEL CASTINGS [4]							
Carbon steel:							
Low-phosphorus plate and punchings	651	6	186	2	840	3	57
Cut structural and plate	229	26	40	1	288	--	25
No. 1 heavy melting steel	177	9	80	--	255	--	32
No. 2 heavy melting steel	34	1	9	--	37	--	8
No. 1 and electric furnace bundles	63	--	7	--	68	--	5
No. 2 and all other bundles	15	--	--	--	15	--	1
Electric furnace 1 foot and under (not bundles)	53	--	27	--	74	2	5
Railroad rails	11	--		--	9		3
Turnings and borings	80	--	27	--	98	7	8
Slag scrap (Fe content 70%)	2	--	5	--	7	--	--

See footnotes at end of table.

Table 2.—U.S. consumer receipts, production, consumption, shipments and stocks of iron and steel scrap in 1974, by grade—Continued

(Thousand short tons)

Grade of scrap	Receipts of scrap: From brokers, dealers, and other outside sources	Receipts of scrap: From other own-company plants	Production of home scrap: Recirculating scrap resulting from current operations	Production of home scrap: Obsolete scrap (includes ingot molds and scrap from old equipment, obsolete buildings, etc.)	Consumption of both purchased and home scrap (includes recirculating scrap)	Shipments of scrap	Ending stocks Dec. 31
MANUFACTURERS OF STEEL CASTINGS—Continued							
Carbon Steel—Continued							
Shredded or fragmentized	77	--	--	--	74	--	4
All other carbon steel scrap	504	12	395	5	907	3	64
Stainless steel scrap	23	5	15	--	39	4	3
Alloy steel (except stainless)	68	15	102	1	167	13	17
Ingot mold scrap	7	--	--	--	6	--	2
Cast iron borings	46	--	40	--	89	--	2
Motor blocks	22	--	--	--	23	--	3
Other iron scrap	94	1	120	1	211	3	25
Other mixed scrap [2]	35	--	26	3	63	--	4
Total scrap [3]	2,191	75	1,078	13	3,269	36	268
Total according to previous sampling panel [5]	2,112	72	1,048	13	3,161	32	262
IRON FOUNDRIES AND MISCELLANEOUS USERS							
Carbon steel:							
Low-phosphorus plate and punchings	847	183	99	5	1,058	21	68
Cut structural and plate	1,498	164	198	10	1,862	21	102
No. 1 heavy melting steel	350	78	92	--	488	27	46
No. 2 heavy melting steel	37	22	40	1	85	8	13
No. 1 and electric furnace bundles	278	241	45	1	574	1	27
No. 2 and all other bundles	557	84	7	2	643	1	46
Electric furnace 1 foot and under (not bundles)	218	70	10	--	300	--	9
Railroad rails	135	--	34	--	162	1	17
Turnings and borings	616	144	36	2	707	46	114
Slag scrap (Fe content 70%)	16	--	9	--	27	1	1
Shredded or fragmentized	835	11	5	--	843	7	42
All other carbon steel scrap	1,514	367	182	1	1,983	20	145
Stainless steel scrap	52	--	5	--	44	1	16
Alloy steel (except stainless)	130	5	10	1	144	1	24
Ingot mold scrap	174	2	29	8	189	10	27
Cast iron borings	1,052	462	810	17	2,266	69	91
Motor blocks	801	26	396	--	1,201	18	54
Other iron scrap	1,209	185	3,697	3	4,948	163	220
Other mixed scrap [2]	1,858	792	1,019	9	3,616	86	143
Total scrap [3]	12,177	2,787	6,674	68	21,140	450	1,200
Total according to previous sampling panel [5]	10,107	2,770	5,754	57	18,174	411	1,120

TOTAL—ALL TYPES OF MANUFACTURERS							
Carbon steel:							
Low-phosphorus plate and punchings	2,226	144	807	9	2,658	27	211
Cut structural and plate	2,118	199	494	18	2,807	29	159
No. 1 heavy melting steel	8,875	2,377	20,256	229	29,016	2,381	2,374
No. 2 heavy melting steel	3,224	236	1,142	7	4,254	114	700
No. 1 and electric furnace bundles	7,115	734	2,720	21	10,297	104	896
No. 2 and all other bundles	3,976	257	474	2	4,314	136	601
Electric furnace 1 foot and under (not bundles)	416	75	108	--	611	2	27
Railroad rails	269	1	34	--	805	1	28
Turnings and borings	2,549	262	399	6	2,990	159	291
Slag scrap (Fe content 70%)	1,650	131	2,436	--	4,087	100	269
Shredded or fragmentized	3,089	329	5	--	3,249	8	261
All other carbon steel scrap	5,550	653	12,411	109	17,541	1,128	798
Stainless steel scrap	552	57	772	1	1,286	57	168
Alloy steel (except stainless)	420	214	2,100	14	2,623	94	261
Ingot mold scrap	630	580	1,139	1,811	3,823	672	397
Cast iron borings	1,602	891	1,847	126	4,082	378	180
Motor blocks	828	26	396	--	1,230	18	58
Other iron scrap	1,778	400	4,623	63	6,263	603	567
Other mixed scrap [2]	2,061	915	1,160	14	4,046	69	167
Total scrap [3]	48,927	8,482	52,821	2,429	105,488	6,074	8,408
Total according to previous sampling panel [5]	46,779	8,462	51,870	2,423	102,409	6,032	8,319

[1] Includes only those castings made by companies producing steel ingots.

[2] Includes machinery and cupola cast iron.

[3] Data may not add to totals shown because of independent rounding.

[4] Excludes companies that produce both steel ingots and steel castings.

[5] An augmented sampling panel for manufacturers of steel castings, iron foundries, and miscellaneous users was employed for the 1974 annual figures. Totals from the panel used prior to 1974 are shown for comparison.

Table 3.—U.S. consumer receipts, production, consumption, shipments, and stocks of pig iron and direct-reduced iron in 1974

(Thousand short tons)

	Receipts	Production	Consumption	Shipments	Stocks Dec. 31
MANUFACTURERS OF PIG IRON AND STEEL INGOTS AND CASTINGS					
Pig iron	6,095	95,473	92,786	9,273	435
MANUFACTURERS OF STEEL CASTINGS					
Pig iron	68	--	62	--	13
Pig iron according to previous sampling panel [1]	66	--	60	--	12
IRON FOUNDRIES AND MISCELLANEOUS USERS					
Pig iron	3,987	--	3,944	27	319
Pig iron according to previous sampling panel [1]	3,452	--	3,423	16	279
TOTAL—ALL TYPES OF MANUFACTURERS					
Pig iron	10,149	95,473	96,792	9,300	763
Pig iron according to previous sampling panel [1]	9,612	95,473	96,269	9,289	726
Direct-reduced or prereduced iron	[2] 627	([3])	614	W	6

W Withheld to avoid disclosing individual company confidential data.

[1] An augmented sampling panel for manufacturers of steel castings, iron foundries, and miscellaneous users was employed for the 1974 annual figures. Figures from the panel used prior to 1974 are shown for comparison.

[2] Receipts and production combined.

[3] Production included in receipts.

Table 4.—Consumption of iron and steel scrap and pig iron in the United States in 1974, by type of consumer and type of furnace, or other use

(Thousand short tons)

Type of furnace or other use	Manufacturers of pig iron and steel ingots and castings		Manufacturers of steel castings		Iron foundries and miscellaneous users		Total all types [1]	
	Scrap	Pig iron	Scrap	Pig iron	Scrap	Pig iron	Scrap	Pig iron
Blast furnace [2]	4,558	--	--	--	--	--	4,558	--
Basic oxygen process [3]	26,614	66,614	--	--	--	--	26,614	66,614
Open-hearth furnace	19,005	22,497	154	11	--	--	19,159	22,507
Electric furnace	29,710	920	2,809	36	4,957	265	37,476	1,220
Cupola furnace	527	234	265	6	14,848	1,883	15,640	2,123
Other (including air furnace)[4]	659	517	42	10	1,335	105	2,037	632
Direct castings [5]	--	2,005	--	--	--	1,692	--	3,696
Total [1]	81,074	92,786	3,269	62	21,140	3,944	105,483	96,792

[1] Data may not add to totals shown because of independent rounding.

[2] Includes consumption in all blast furnaces producing pig iron.

[3] Includes scrap and pig iron processed in metallurgical blast cupolas and used in oxygen converters.

[4] Includes vacuum melting furnaces and miscellaneous uses.

[5] Includes ingot molds and stools.

Table 5.—Proportion of iron and steel scrap and pig iron used in furnaces in the United States

(Percent)

Type of furnace	1974	
	Scrap	Pig iron
Basic oxygen process	28.5	71.5
Open-hearth furnace	46.0	54.0
Electric furnace	96.8	3.2
Cupola furnace	88.0	12.0
Other (including air furnace)	76.3	23.7

Table 6.—Iron and steel scrap supply[1] available for consumption in 1974, by State and region

(Thousand short tons)

State and region	Receipts of scrap		Productions of home scrap		Total new supply [2]	Shipments of scrap [3]	New supply available for consumption
	From brokers, dealers, and other outside sources	From other own-company plants	Recirculating scrap resulting from current operations	Obsolete scrap (includes ingot molds, stools, and scrap from old equipment buildings, etc.)			
New England and Middle Atlantic:							
Connecticut, Maine, Massachusetts, New Hampshire, New Jersey, New York, Rhode Island, Vermont	2,109	312	2,153	74	4,649	184	4,465
Pennsylvania	8,279	1,960	12,600	532	23,370	2,309	21,062
Total [2]	10,387	2,273	14,753	606	28,019	2,493	25,526
North Central:							
Illinois	5,751	875	4,281	233	11,140	441	10,699
Indiana	3,538	218	8,261	342	12,359	581	11,778
Michigan, Iowa, Minnesota, Nebraska, Kansas, Missouri	6,796	2,083	4,514	260	13,653	302	13,352
Ohio	7,085	1,873	9,076	513	18,547	1,467	17,080
Wisconsin	751	21	595	2	1,370	19	1,351
Total [3]	23,921	5,071	26,727	1,351	57,070	2,810	54,260
South Atlantic:							
Delaware, Florida, Georgia, Maryland, North Carolina, South Carolina, Virginia, West Virginia	3,768	264	3,562	289	7,882	119	7,764
South Central:							
Alabama, Arkansas, Kentucky, Louisiana, Mississippi, Oklahoma, Tennessee, Texas	6,757	454	4,777	103	12,091	454	11,637
Mountain and Pacific:							
Arizona, California, Colorado, Montana, Nevada, Oregon, Utah, Washington	4,094	420	3,002	80	7,596	198	7,398
U.S. Total [3]	48,927	8,482	52,821	2,429	112,658	6,074	106,584

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[1] New supply available for consumption is a net figure computed by adding production to receipts and deducting scrap shipped during the year. The plus or minus difference in stock levels at the beginning and end of year is not taken into consideration.

[2] Data may not add to totals shown because of independent rounding.

[3] Includes scrap shipped, transferred, or otherwise disposed of during the year.

Table 7.—Consumption of iron and steel scrap and pig iron[1] by State and region, by type of manufacturer in 1974

(Thousand short tons)

State and region	Pig iron and steel ingots and castings		Steel castings		Iron foundries and miscellaneous users		Total[2]	
	Scrap	Pig iron	Scrap	Pig iron	Scrap	Pig iron	Scrap	Pig iron
New England and Middle Atlantic:								
Connecticut, Maine, Massachusetts, New Hampshire, New Jersey, New York, Rhode Island, Vermont	2,771	4,149	221	8	1,458	404	4,450	4,562
Pennsylvania	19,128	21,676	436	28	1,224	777	20,788	22,481
Total[2]	21,899	25,825	657	37	2,682	1,181	25,238	27,043
North Central:								
Illinois	8,499	6,869	485	1	1,605	411	10,589	7,281
Indiana	10,608	17,044	217	1	912	136	11,736	17,182
Michigan, Iowa, Minnesota, Nebraska, Kansas, Missouri	6,598	7,316	422	2	6,243	684	13,262	8,001
Ohio	13,619	16,496	310	12	3,119	753	17,048	17,262
Wisconsin	--	--	315	1	1,036	129	1,352	130
Total[2]	39,324	47,725	1,748	17	12,915	2,114	53,987	49,856
South Atlantic:								
Delaware, Florida, Georgia, Maryland, North Carolina, South Carolina, Virginia, West Virginia	6,194	7,556	88	1	1,478	184	7,759	7,742
South Central:								
Alabama, Arkansas, Kentucky, Louisiana, Mississippi, Oklahoma, Tennessee, Texas	7,794	6,636	376	1	3,160	378	11,330	7,015
Mountain and Pacific:								
Arizona, California, Colorado, Montana, Nevada, Oregon, Utah, Washington	5,863	5,043	400	7	904	87	7,168	5,137
U.S. total[2]	81,074	92,786	3,269	62	21,140	3,944	105,483	96,792

[1] Includes molten pig iron used for ingot molds and direct castings.
[2] Data may not add to totals shown because of independent rounding.

Table 8.—Consumer stocks of iron and steel scrap, by grade, and pig iron, Dec. 31, 1974, by State and region

(Thousand short tons)

State and region	Carbon steel (excludes rerolling rails)	Stainless steel	Alloy steel (excludes stainless)	Cast iron (includes borings)	Other grades of scrap	Total scrap stocks [1]	Pig iron stocks
New England and Middle Atlantic:							
Connecticut, Maine, Massachusetts, New Hampshire, New Jersey, New York, Rhode Island, Vermont	343	36	16	61	15	472	35
Pennsylvania	1,247	63	125	177	13	1,624	139
Total [1]	1,590	99	141	238	28	2,095	174
North Central:							
Illinois	797	3	9	70	2	882	31
Indiana	724	5	6	257	4	996	54
Michigan, Iowa, Minnesota, Nebraska, Kansas, Missouri	672	29	3	129	49	881	119
Ohio	825	17	35	189	16	1,082	133
Wisconsin	24	1	(2)	13	1	39	20
Total [1]	3,041	56	53	658	73	3,881	356
South Atlantic:							
Delaware, Florida, Georgia, Maryland, North Carolina, South Carolina, Virginia, West Virginia	375	6	24	80	2	488	47
South Central:							
Alabama, Arkansas, Kentucky, Louisiana, Mississippi, Oklahoma, Tennessee, Texas	973	(2)	23	167	47	1,211	160
Mountain and Pacific:							
Arizona, California, Colorado, Montana, Nevada, Oregon, Utah, Washington	636	2	20	59	17	733	26
U.S. total [1]	6,615	163	261	1,202	166	8,408	763

[1] Data may not add to totals shown because of independent rounding.
[2] Less than ½ unit.

Table 9.—Average monthly price and composite price for No. 1 heavy melting scrap in 1974

(Per long ton)

Month	Chicago	Pittsburgh	Philadelphia	Composite price [1]
January	$89.50	$85.75	$75.75	$83.67
February	115.75	105.75	99.50	107.00
March	125.75	119.50	121.88	122.38
April	135.50	116.60	121.00	124.37
May	98.25	92.00	96.40	95.55
June	114.50	105.75	110.38	110.21
July	136.30	128.50	118.00	127.60
August	119.50	113.00	112.75	115.09
September	114.50	114.50	116.10	115.04
October	114.50	119.50	124.75	119.58
November	102.00	98.50	104.00	101.50
December [e]	83.25	75.75	81.75	80.25
Average 1974 [e]	112.44	106.26	106.86	108.52
Average 1973	57.64	57.59	58.62	57.95

[e] Estimated.
[1] Composite price, Chicago, Pittsburgh, and Philadelphia.

Source: Iron Age, Jan. 6, 1975.

Table 10.—U.S. exports and imports for consumption of iron and steel scrap, by class

(Thousand short tons and thousand dollars)

Class	1970		1971		1972		1973		1974	
	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value
Exports:										
No. 1 heavy melting scrap	3,654	158,483	1,827	64,514	2,289	79,246	3,780	207,743	2,565	262,810
No. 2 heavy melting scrap	1,140	45,516	645	20,297	756	23,200	1,107	52,817	883	84,826
No. 1 bundles	377	16,290	233	8,460	180	6,112	391	21,565	78	8,504
No. 2 bundles	1,381	41,902	987	22,519	897	19,623	1,221	49,421	1,304	99,652
Stainless steel scrap	87	30,926	44	12,518	48	11,679	49	16,731	35	15,351
Shredded steel scrap	1,165	49,344	1,026	36,568	1,463	48,186	2,098	118,133	1,999	225,990
Borings, shovelings, and turnings	619	15,311	390	8,663	508	10,761	521	16,352	544	35,404
Other steel scrap[1]	881	44,423	465	19,030	597	21,562	1,102	57,528	463	40,814
Iron scrap	807	29,715	465	13,851	439	13,026	605	29,721	626	50,369
Total	10,111	431,910	6,082	206,420	7,177	233,395	10,874	570,011	8,497	823,720
Ships, boats, and other vessels (for scrapping)	531	11,474	396	6,824	299	9,009	156	8,056	327	33,140
Rerolling material	251	15,464	175	8,978	207	10,213	382	28,489	199	25,025
Total exports	10,893	458,848	6,653	222,222	7,683	252,617	11,412	606,556	9,023	881,885
Imports:										
Iron and steel scrap	279	10,609	268	10,713	295	14,304	337	18,716	188	26,166
Tinplate scrap	22	591	20	546	17	437	12	384	13	861
Total	301	11,200	288	11,259	312	14,741	349	19,100	201	27,027

[1] Includes terneplate and tinplate.

Table 11.—U.S. exports of iron and steel scrap, by country

(Thousand short tons and thousand dollars)

Country	1970		1971		1972		1973		1974	
	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value
Argentina	6	370	63	1,757	231	7,857	261	13,840	148	16,189
Belgium-Luxembourg	21	3,563	8	947	5	300	3	535	(1)	105
Brazil	--	--	1	15	61	2,174	5	229	27	3,821
Canada	707	21,525	887	26,204	903	26,605	811	27,097	940	52,296
Chile	(1)	4	3	305	5	417	15	1,255	23	2,828
China, Peoples Republic of	--	--	--	--	--	--	428	23,729	189	12,406
France	57	2,785	8	298	(1)	5	30	2,682	16	4,019
Germany, West	45	2,069	13	1,152	7	473	2	283	4	1,481
Greece	--	--	37	1,228	163	4,893	187	9,429	113	12,762
Hong Kong	6	652	26	1,023	1	277	1	231	1	83
Israel	(1)	2	--	--	--	--	(1)	6	27	2,857
Italy	491	22,657	590	22,599	717	23,222	353	23,966	485	58,896
Japan	5,208	208,601	1,744	54,369	2,309	71,309	4,666	234,363	2,980	305,228
Korea, Republic of	667	30,971	324	11,799	380	13,086	739	42,429	680	76,754
Mexico	821	35,368	555	20,027	587	22,301	1,009	56,063	890	72,432
New Zealand	7	338	--	--	19	535	42	2,479	17	2,189
Pakistan	(1)	11	52	1,639	[2] 21	[2] 766	1	96	[2] 48	[2] 6,206
Peru	3	117	--	--	6	443	--	--	23	3,103
Singapore	--	--	--	--	25	971	15	1,179	--	--
Spain	1,154	45,725	610	20,354	721	21,452	1,127	58,197	896	89,696
Sweden	161	24,712	20	4,487	21	4,545	8	2,171	33	5,188
Taiwan	151	7,097	387	12,584	419	14,028	672	39,527	491	44,454
Thailand	45	1,950	39	1,464	85	2,945	139	8,408	34	3,311
Turkey	72	3,580	73	2,465	125	4,571	124	7,212	57	6,823
United Kingdom	251	10,909	335	12,785	25	1,029	142	9,203	117	14,442
Venezuela	179	5,587	212	5,244	284	7,734	76	3,802	183	17,679
Yugoslavia	22	1,006	56	2,271	--	--	--	--	--	--
Other	37	2,361	39	1,454	57	1,457	18	1,600	75	9,527
Total	10,111	431,910	6,082	206,420	7,177	233,395	10,874	570,011	8,497	823,720

[1] Less than ½ unit.

[2] Includes Bangladesh: 1972, 14,781 short tons ($521,810); 1974, 8,678 short tons ($1,019,214).

Table 12.—U.S. exports of rerolling material (scrap), by country

(Thousand short tons and thousand dollars)

Country	1970		1971		1972		1973		1974	
	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value
Canada	5	208	1	46	2	118	1	34	7	485
China, People's Republic of	--	--	--	--	--	--	7	485	1	85
Italy	2	114	1	44	--	--	2	168	--	--
Japan	13	584	5	190	17	789	16	1,209	1	182
Korea, Republic of	187	11,737	83	4,562	73	3,491	118	7,014	81	10,504
Mexico	33	2,036	27	1,530	35	1,883	43	2,954	47	5,269
Pakistan	--	--	--	--	24	1,047	8	422	4	617
Spain	--	--	1	59	5	319	(1)	7	--	--
Taiwan	(1)	10	44	2,023	20	951	149	12,712	57	7,712
Thailand	6	398	--	--	15	654	28	2,641	--	--
Turkey	--	--	--	--	9	533	4	292	(1)	40
Venezuela	2	99	2	105	3	200	3	210	--	--
Yugoslavia	--	--	11	419	--	--	--	--	--	--
Other	3	278	--	--	4	228	3	341	1	131
Total	251	15,464	175	8,978	207	10,213	382	28,489	199	25,025

[1] Less than ½ unit.

Table 13.—U.S. exports of ships, boats, and other vessels for scrapping

(Thousand short tons and thousand dollars)

Country	1970		1971		1972		1973		1974	
	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value
Canada	18	338	30	493	36	583	2	260	26	1,414
Germany, West	15	197	5	77	--	--	8	257	13	700
Italy	48	913	--	--	--	--	--	--	--	--
Japan	6	100	--	--	5	74	--	--	--	--
Korea, Republic of	7	169	--	--	--	--	9	370	44	5,826
Mexico	--	--	--	--	--	--	1	132	(1)	23
Netherlands	15	275	--	--	--	--	(1)	40	--	--
Spain	357	7,637	255	4,788	146	3,907	22	1,002	93	8,824
Taiwan	58	1,607	106	1,463	112	4,445	114	5,994	139	15,539
Other	7	238	(1)	3	--	--	(1)	1	12	814
Total	531	11,474	396	6,824	299	9,009	156	8,056	327	33,140

[1] Less than ½ unit.

Table 14.—U.S. imports for consumption of iron and steel scrap, by country

Country	1973		1974	
	Quantity (short tons)	Value (thousands)	Quantity (short tons)	Value (thousands)
Argentina	176	$6	--	--
Australia	18	1	114	$55
Bahamas	--	--	178	33
Canada	336,119	17,696	195,363	25,005
Chile	--	--	196	10
Costa Rica	29	1	85	8
Dominican Republic	83	6	671	46
Finland	--	--	81	116
Germany, West	55	46	72	25
Haiti	785	9	155	6
Hong Kong	--	--	124	67
Jamaica	1,686	73	1,530	80
Japan	19	1	30	28
Leeward and Windward Islands	--	--	105	25
Liberia	650	21	28	1
Mexico	6,606	151	979	92
Netherlands	816	323	255	584
Sweden	139	49	--	--
Taiwan	--	--	110	19
Trinidad and Tobago	--	--	178	7
United Kingdom	1,365	713	611	788
Other	87	4	260	32
Total	348,633	19,100	201,125	27,027

Iron Oxide Pigments

By Thomas S. Jones [1]

Overall levels of production and trade in iron oxide pigments for 1974 remained about the same as those in 1973, although there were shifts for specific oxides. Significant uses were in protective paints for metal and wood, automotive finishes, coil coatings, ferrite manufacture, and coloring of construction materials. Sales and consumption of pigments followed general economic trends; demand remained up until the last quarter, when there was a marked drop. On the plus side were paint trade sales and precoated steel; on the minus side were the housing and construction industries. At the end of 1974, coatings manufacturers were reportedly reducing inventories and maintaining cash flow to raise liquidity. Thus, the apparent adequacy of supply at yearend tended to reflect a short-term decrease in demand rather than an increase in output. This was true for paint raw materials in general, for which the longer term outlook is uncertain. Plans announced for increasing manufacturing capacity for iron oxides should alleviate recent pigment shortages. Oxide prices, especially for synthetics, rose after the expiration of controls.

Table 1.—Salient iron oxide pigments statistics in the United States

	1970	1971	1972	1973	1974
Mine production ______ short tons __	38,600	W	W	W	W
Crude pigments sold or used ______ do ____	39,200	W	W	W	W
Value ______ thousands __	$442	$415	$418	[r] $931	$1,429
Finished pigments sold ______ short tons __	124,000	128,300	[r] 152,412	[r] 148,802	149,664
Value ______ thousands __	$28,000	$31,000	[r] $37,673	[r] $43,514	$60,276
Exports ______ short tons __	4,600	4,000	4,300	9,900	9,700
Value ______ thousands __	$1,600	$1,700	$1,900	$3,100	$3,500
Imports for consumption ______ short tons __	32,700	36,500	47,300	51,200	54,200
Value ______ thousands __	$5,800	$6,200	$8,500	$12,000	$16,400

[r] Revised. W Withheld to avoid disclosing individual company confidential data.

DOMESTIC PRODUCTION

Overall production of crude iron oxide pigments showed an increase of about 5% over that of 1973; specific figures are confidential and cannot be released. Value of shipments rose to $1.4 million, a 53% increase over that of 1973. Production of crude pigments in 1974 was reported by four companies operating in four Midwestern and Eastern States. The Cleveland-Cliffs Iron Co. produced the largest quantity from ore mined in Michigan. Red, yellow (ocher and sienna), black, and brown (umber) oxides were produced from the various mines; one color was produced at each location, except that yellows and browns were both obtained from the same site.

Domestic shipments of finished iron oxide pigments in 1974 were 149,664 short tons, almost the same as those in 1973. Value of shipments increased 39% to $60.3 million, largely as a result of a nearly 50% increase in the average unit value of synthetic oxides, which rose from $0.196 to $0.293 per pound. At $0.075 per pound, the average unit value of natural oxides was virtually unchanged from that of 1973. Synthetic oxides constituted 51% of finished pigments shipments, natural oxides accounted for 43%, and the balance consisted of mixtures and unspecified products. Thus, although the respective tonnages of synthetic and natural pigments did not differ greatly, the value of synthetic pigments was 4 to 5 times that of natural oxides.

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[1] Physical scientist, Division of Ferrous Metals.

In 1974, 15 companies reported shipments of finished pigments from 20 plants in 11 Eastern and Midwestern States and California. Pfizer Inc. was a major shipper of both synthetic and natural oxides. Cities Service Co., with plants in Missouri and New Jersey, was also a major producer of synthetic oxides. In addition to Pfizer, firms reporting relatively large shipments of natural oxides were Blue Ridge Talc Co., Inc. in Virginia, Delta Color & Supply Co. in Wisconsin, Prince Manufacturing Co. with plants in Illinois and Pennsylvania, and Reichard-Coulston, Inc. in Pennsylvania.

Pfizer completed an expansion of production facilities for synthetic red and yellow oxides at its Emeryville, Calif., plant, and announced plans for adding capacity at three other locations.[2] At East St. Louis, Ill., capacity for production of red oxides was to be doubled and production of yellow oxide was to be increased 40%. At Easton, Pa., capacity for red oxide for magnetic applications was to be enlarged 15,000 tons per year by 1976. A new plant is expected to be completed in 1978 at Sayreville, N.J., for annual production of 12,000 tons of yellow oxide for paint, automotive coating, plastics, and construction materials applications.

BASF Wyandotte Corp. announced plans for a plant at Wyandotte, Mich., for production by mid-1975 of 1,500 tons per year of transparent iron oxides. Trade journals alluded to pending expansions of other companies, along with some difficulty in carrying out planned expansions. Shortly before the end of 1973, Hoover Color Co. of Irvington, N.J., purchased and took over operation of pigment facilities at Hiwassee, Va., formerly owned by Hercules Inc.

CONSUMPTION AND USES

As inferred from data on shipments of finished pigments shown in table 2, the amount and pattern of consumption of iron oxide pigments was much the same in 1974 as it was in 1973. Demand paralleled the state of the economy. Augmented by overseas interest, demand ran equal to or ahead of supply until the fourth quarter; supply was complicated by shortages and the high cost of iron scrap. However, a marked decrease in demand in the fourth quarter kept shipments for the year level with those for 1973. The majority of shipments consisted of red and yellow synthetic oxides and red and brown natural oxides. Use of both natural and synthetic red oxides showed a slight increase, and accounted for nearly half of total consumption. Shipments of brown oxides declined about 15%. Shipments of black oxides shifted from mostly natural grades in 1973 to mostly synthetic grades in 1974. Only small amounts of Venetian red and Vandyke brown were shipped, although several times as much Vandyke brown was imported as was shipped domestically.

Data are not collected by the Bureau of Mines on specific uses for iron oxide pigments. Figures given in table 2 do not necessarily reflect all sales of iron oxides used for pigments and other nonsmelting purposes. Natural and synthetic iron oxides are used for coloring purposes in a wide range of paints, as well as in plastics, rubbers, mortars, concrete, stains, and other products. A major use for both natural and synthetic oxides is metal and wood protection systems. Natural oxides are used particularly in protective coatings for ships, structural steel, freight cars, barns, roofs, and floors. Transparent oxides find use in metallic finishes, especially for automotive, coil, and other decorative coatings. Significant quantities of iron oxide, chiefly synthetic grades, are used to manufacture hard and soft ferrites for magnetic tapes, magnet cores, and other electronic applications. Iron oxides are used in catalysts in the chemical industry. Because of their nontoxic nature, iron oxide pigments are used in cosmetics, drugs, and a number of food applications.

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[2] American Paint Journal. Pfizer To Build Major Iron Oxide Plant On Site Near Sayreville, N.J. V. 59, No. 7, Sept. 2, 1974, p. 19.

Table 2.—Finished iron oxide pigments sold by processors in the United States, by kind

Pigment	1973 r		1974	
	Short tons	Value (thousands)	Short tons	Value (thousands)
Natural:				
Brown:				
Iron oxide (metallic)[1]	15,981	$3,304	13,252	$3,027
Umbers:				
Burnt	6,604	1,889	5,400	1,783
Raw	1,745	512	1,631	501
Red:				
Iron oxide[2]	31,576	2,518	34,957	2,829
Sienna, burnt	900	414	964	475
Yellow:				
Ocher[3]	6,085	474	7,094	670
Sienna, raw	1,330	419	1,055	379
Total natural	64,221	9,530	64,353	9,664
Synthetic:				
Black: Magnetic	3,102	1,988	4,779	2,915
Brown: Iron oxide	7,258	3,240	5,370	3,394
Red: Iron oxides	33,431	12,075	34,153	19,476
Yellow: Iron oxide	34,605	13,389	32,202	18,971
Total synthetic:	78,396	30,692	76,504	44,756
Unspecified, including mixtures of natural and synthetic iron oxides	6,185	3,292	8,807	5,856
Grand total	148,802	43,514	149,664	60,276

r Revised.
[1] Includes black magnetite and Vandyke brown.
[2] Includes pyrite cinder.
[3] Includes yellow iron oxide.

PRICES

In May, nearly all iron oxide pigments increased significantly in price following the expiration of price controls. The greatest price increase was for synthetic oxides; the price of most colors increased again in the fall, leading to prices at yearend of 60% to 80% above those prevailing at the beginning of 1974. Price increases for natural oxides were less; many colors increased about 40% in price during the year. The prices of metallic brown and raw American sienna rose relatively little (about 10%), whereas domestic ocher did not change in price at all.

Table 3.—Prices quoted on finished iron oxide pigments, per pound, quantity shipments, as of December 30, 1974

Pigment	Low	High	Pigment	Low	High
Black: Synthetic	$0.3100	$0.3200	Red:		
Brown:			Domestic primers	--	$0.1500
Metallic	.1175	.1275	Persian Gulf[1]	--	--
Pure, synthetic	.3525	.4000	Pure, synthetic	$0.3475	.3725
Sienna, American, burnt	.2600	.3700	Spanish, exdock, N.Y.[1]	--	--
Sienna, American, raw	.1800	.2800	Yellow:		
Umber, American, burnt	--	.1925	Synthetic	.3350	.3650
Umber, American, raw	.1800	.2200	Ocher, domestic	.0650	--
Vandyke, imported	--	.2250	Natural, French type	.1800	--
Vandyke, American[1]	--	--	Pure, light lemon	.3450	.3650
			Other shades	.3350	.3550

[1] Not quoted after May 13.

Sources: American Paint Journal and Chemical Marketing Reporter.

FOREIGN TRADE

U.S. exports of pigment-grade iron oxides and hydroxides decreased 2.2% from those of 1973 to 9,666 short tons. However, value rose 11.8% to $3.47 million because of a 14% increase in average unit value to $0.179 per pound. Exports to Canada grew strongly to over three-fourths of total exports, whereas those to Brazil, the United Kingdom, Japan, and Italy dropped sharply.

Imports of iron oxide pigments for consumption grew in 1974 to 54,215 short tons, an increase of 5.9% over the 51,183 short tons imported in 1973. Overall growth in imports was due to increased receipts of synthetic pigments, which rose 12% to 41,943 short tons. Imports of natural pigments decreased 11% to below even the 1972 volume of 12,997 short tons. The value of iron oxide pigment imports increased 36% compared with that of 1973 to $16.4 million. The average unit values showed increases for both synthetic and natural oxide imports of 25% and 20% to $0.179 and $0.057 per pound, respectively.

Synthetic oxides represented 77% of the tonnage and 91% of the value of imports. Receipts from West Germany, Canada, and Japan, in that order, were almost wholly synthetic material, and accounted for 92% of synthetics. Imports of synthetic oxides from West Germany, Japan, and the United Kingdom increased sizably over those in 1973, and more than offset a 25% decrease in Canadian imports. The increase in imports from Japan was particularly notable, nearly 400% at an average unit value only 40% of that for 1973, possibly reflecting a large increase in imports of pigment-grade material. Imports of natural umbers and siennas from Cyprus made that country the third largest import source overall. Shipments reported from Cyprus accounted for 94% of imported umbers and 34% of imported siennas, with the balance of the latter coming from Italy.

Bayer A.-G. in West Germany was reportedly undertaking staged expansion of production capacity for synthetic iron oxide pigments. The first stage was expected to increase production in 1975, and was to be followed by further expansion that would ultimately result in production in 1978 nearly 50% greater than that in 1974. Red, yellow, brown, or black oxide was to be obtained, depending on how processing is carried out. Early in 1974, troubles in obtaining red oxides from import sources were reported, at least partly due to price difficulties. Spanish iron oxides were in short supply because of worldwide demand.

Table 4.—U.S. exports of iron oxide and hydroxides by country

Destination	1973				1974			
	Pigment grade		Other grade		Pigment grade		Other grade	
	Quantity (short tons)	Value (thousands)	Quantity (short tons)	Value (thousands)	Quantity (short tons)	Value (thousands)	Quantity (short tons)	Value (thousands)
Australia	307	$198	70	$88	242	$269	57	$83
Bahamas	(1)	(1)	--	--	12	5	36	54
Belgium-Luxembourg	62	28	38	18	70	40	147	92
Brazil	806	302	90	83	52	47	178	145
Canada	6,096	1,152	993	503	7,590	1,422	1,526	1,098
Colombia	21	11	24	14	32	18	93	90
Ecuador	114	83	4	2	17	5	2	1
France	189	149	172	116	184	174	148	98
Germany, West	75	116	182	146	192	427	101	57
India	3	1	34	38	23	8	23	35
Indonesia	--	--	49	8	--	--	--	--
Italy	175	92	527	597	69	50	696	744
Japan	262	103	806	748	129	98	1,358	1,718
Mexico	111	110	6	6	142	94	80	73
Netherlands	7	5	424	345	33	37	478	593
New Zealand	91	29	--	--	22	21	7	16
Philippines	94	31	10	5	17	15	24	18
Saudi Arabia	1	(1)	54	54	--	--	--	--
Spain	19	10	27	10	30	16	37	20
United Kingdom	797	344	803	693	334	281	682	806
Venezuela	216	86	47	32	167	159	58	41
Vietnam, South	101	57	9	4	23	18	--	--
Other	341	194	106	91	286	262	188	189
Total	9,888	3,101	4,475	3,601	9,666	3,466	5,919	5,971

[1] Less than ½ unit.

Table 5.—U.S. imports for consumption of selected iron oxide pigments

Kinds	1973		1974	
	Quantity (short tons)	Value (thousands)	Quantity (short tons)	Value (thousands)
Natural:				
Crude:				
Ochers	--	--	13	$5
Siennas	1,138	$195	1,198	243
Umbers	8,484	402	6,748	365
Other	142	52	230	67
Total	9,764	649	8,189	680
Refined:				
Ochers	66	9	40	5
Siennas	54	10	111	21
Umbers	1,181	167	1,042	200
Vandyke brown	966	144	958	183
Other	1,716	326	1,932	309
Total	3,983	656	4,083	718
Synthetic	37,436	10,700	41,943	14,969
Grand total	51,183	12,005	54,215	16,367

Table 6.—U.S. imports for consumption of iron oxide and iron hydroxide pigments, by country

Country	Natural				Synthetic			
	1973		1974		1973		1974	
	Quantity (short tons)	Value (thousands)	Quantity (short tons)	Value (thousands)	Quantity (short tons)	Value (thousands)	Quantity (short tons)	Value (thousands)
Austria	30	$8	--	--	--	--	--	--
Belgium-Luxembourg	21	4	3	$11	20	$2	30	$7
Canada	1	3	128	82	15,506	2,574	11,706	2,685
Cyprus	9,330	486	7,763	502	--	--	--	--
Ecuador	--	--	--	--	18	5	--	--
Finland	--	--	--	--	60	26	--	--
France	56	9	--	--	--	--	38	15
Germany, West	1,277	334	986	213	18,782	6,633	22,312	9,412
Hong Kong	--	--	--	--	--	--	52	22
India	--	--	110	12	--	--	55	6
Iran	--	--	--	--	25	7	--	--
Italy	911	186	870	211	--	--	--	--
Japan	1	([1])	128	46	945	911	4,697	1,804
Korea, Republic of	--	--	29	15	--	--	114	56
Mexico	--	--	3	([1])	447	112	493	170
Netherlands	20	4	53	15	248	127	20	10
South Africa, Republic of	60	7	20	4	--	--	--	--
Spain	1,506	151	1,694	215	--	--	216	65
Sweden	17	5	5	2	--	--	--	--
Switzerland	1	4	--	--	--	--	--	--
United Kingdom	516	104	480	120	1,890	303	2,210	717
Total	13,747	1,305	12,272	1,398	37,436	10,700	41,943	14,969

[1] Less than ½ unit.

TECHNOLOGY

Waterborne paint systems were being developed for application in automotive, appliance, coil coating, and general industrial primers and topcoats. This was in response to predictions that waterborne systems will grow to 50% of industrial paint usage within 2 years. Iron oxides will be a major pigment source in these systems, especially synthetic reds and blacks and certain natural reds and browns.[3]

Because several years are required to evaluate pigment resistance to natural weathering, studies were made of accelerated weathering tests. Testing involved variations of the "Dew Cycle" test, applied to red and yellow iron oxides in different binders. Chalking measurements were found to be the best guide to pigment performance.[4]

Preparation and properties of natural and synthetic iron oxide pigments were reviewed in volume 1 of the recently issued Pigment Handbook.[5] The anticorrosion characteristics of paints containing micaceous iron oxide were described.[6] The pigment is prepared from Austrian specular hematite. While little used so far in the United States, paints pigmented with micaceous iron oxide have been been used to protect structural steel for many years in Europe with notable results.[7]

A precipitation process was developed for preparing zinc ferrite yellow pigments having improved high temperature heat stability.[8]

Specifications were developed on the use of excess alkali in the preparation of seed crystals from which acicular gamma ferric oxide for magnetic recording applications was subsequently produced.[9]

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[3] American Paint Journal. Suitability of Iron Oxides, Extenders in Aqueous Systems is Detroit Topic. V. 59, No. 28, Dec. 23, 1974, p. 35.

[4] Vanderheiden, D. B. Iron Oxide Pigment Performance. Paint Varnish Prod., v. 64, No. 9, September 1974, pp. 19–23.

[5] Patton, T. C. (ed.). Pigment Handbook. John Wiley & Sons, Inc., New York, v. 1, 1973, pp. 323–349, 759–765.

[6] Treade, M. 316 Micaceous Iron Oxide—For Use as a Barrier Coat in Anti-Corrosive Paint Systems. Am. Paint J., v. 59, No. 10, Sept. 23, 1974, pp. 52–53, 56, 62–63.

[7] Anti-Corrosion Methods and Materials. It's All Taken for Granted. V. 21, No. 5, May 1974, pp. 9–10.

[8] Smith, G. B., and K. A. Orlandini (assigned to George B Smith Laboratories, Sycamore, Ill.). Preparation of Zinc Ferrite Yellow Pigments. U.S. Pat. 3,832,455, Aug. 27, 1974.

[9] Pingaud, B-J. (assigned to Eastman Kodak Co., Rochester, N.Y.). Process for Producing Fine Acicular Gamma Ferric Oxide Crystals. U.S. Pat. 3,843,773, Oct. 22, 1974.

Marcot, G. G. (assigned to Bell & Howell Co., Pasadena, Calif.). Acicular Gamma Iron Oxide Process. U.S. Pat. 3,845,198, Oct. 29, 1974.

Methods continued to be developed for preparing iron oxides from other iron salts contained in waste or byproduct streams of metals or mineral processing operations. The National Research Development Corporation, New Delhi, India, announced plans to produce small tonnages of extra-high-quality red iron oxide pigment, using ferrous sulfate in steel-plant pickling waste as feed material. Sulfate from pickle liquor will be roasted with sodium carbonate, and the reaction mass water-leached to give an iron oxide residue.[10] As from ilmenite chlorination, oxidation of ferric chloride by a mixture of pure oxygen and nitrous oxide was found to yield pigment-grade iron oxide and recyclable chlorine.[11] A process was developed for making a black, iron oxide-containing composite pigment particularly suitable for coloring building materials.[12] It was found that magnetic fluids (ferrofluids) can be prepared from industrial wastes by a precipitation and peptization technique.[13]

Several ways of using iron oxide pigments to produce special-purpose coatings were patented. A method was developed for precipitating extremely small magnetite particles which could be dispersed to form magnetic paint or printing ink.[14] Admixing of amines was found to give flocculation stability to colored iron oxide pigments with good corrosion resistance.[15] An iron oxide-containing solution was devised for simultaneously coloring and preserving wafers of yellow pine dipped into the solution.[16]

In using manganese, chromium, or iron ore to color shaped clay products such as bricks, it was found that better color development was promoted by coaddition of boron-containing fluxes or of other materials.[17]

Different methods of preparing ferrites were tested to determine which gave the most favorable product properties. Freeze drying was found a more desirable solution preparation procedure than either spray drying or coprecipitation in making lithium ferrites.[18] Coprecipitation from a chloride solution as a first step in the preparation of barium ferrite was reported to lead to a higher than customary value for coercive force because of fine particle size and freedom from defects ordinarily caused by milling.[19] A novel technique used to prepare magnesium-manganese ferrite and other ceramic oxide powders consisted of liquid drying aqueous solution droplets in a swirling acetone bath.[20] Magnetic recording disks have been made by spin coating nitrate solution onto metal disks, followed by heating and hydrogen reduction.[21] A titania undercoat improved magnetic properties of ferrite thin films prepared in this manner. Lithium ferrites were reviewed and compared with other spinel ferrites and garnets for microwave applications.[22]

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[10] Chemical Age International. New Pigment Process. V. 108, No. 2856, Apr. 12, 1974, p. 11.

[11] Rennick, R. D., and H. C. Reed (assigned to Kerr-McGee Chemical Corporation, Oklahoma City, Okla.). Oxidation of Ferric Chloride. U.S. Pat. 3,830,905, Aug. 20, 1974.

[12] Hahnkamm, V., J. Rademachers, H. Henkel, K. Brandle, and K. Schafer (assigned to Bayer A.-G., Germany). Production of Composite Pigments of Iron Oxide and Carbon Black. U.S. Pat. 3,836,378, Sept. 17, 1974.

[13] Reimers, G. W., and S. E. Khalafalla (assigned to U.S. Department of the Interior). Production of Magnetic Fluids by Peptization Techniques. U.S. Pat. 3,843,540, Oct. 22, 1974.

[14] Cohen, E. S., and R. H. Shubert (assigned to U.S. Department of the Interior). Magnetite Coating Composition. U.S. Pat. 3,826,667, July 30, 1974.

[15] Bockmann, A., P. Kresse, H. Rudolph, and H. Printzen (assigned to Bayer A.-G., Germany). Colored Inorganic Pigments. U.S. Pat. 3,840,383, Oct. 8, 1974.

[16] Hill, R. D. (assigned to Koppers Co., Inc., Pittsburgh, Pa.). Aesthetic Wood Product. U.S. Pat. 3,839,073, Oct. 1, 1974.

[17] Fishwick, J. H. (assigned to Foote Mineral Company, Exton, Pa.). Colorant Composition for Clay Products and Method of Making Colored Clay Products. U.S. Pat. 3,844,812, Oct. 29, 1974.

[18] Johnson, D. W., Jr., P. K. Gallagher, D. J. Nitti, and F. Schrey. Effect of Preparation Technique and Calcination Temperature on the Densification of Lithium Ferrites. Bull. Am. Ceram. Soc., v. 53, No. 2, February 1974, pp. 163–167.

[19] Haneda, K., C. Miyakawa, and H. Kojima. Preparation of High-Coercivity $BaFe_{12}O_{19}$. J. Am. Ceram. Soc., v. 57, No. 8, August 1974, pp. 354–357.

[20] Jaeger, R. E., and T. J. Miller. Preparation of Ceramic Oxide Powders by Liquid Drying. Bull. Am. Ceram. Soc., v. 53, No. 12, December 1974, pp. 855–859.

[21] Comstock, R. L., and E. B. Moore. Ferrite Film Recording Surfaces for Disk Recording. IBM J. Res. Dev., v. 18, No. 6, November 1974, pp. 556–562.

[22] Argentina, G. M., and P. D. Baba. Microwave Lithium Ferrites: An Overview. IEEE Trans. Microwave Theory and Techniques, v. MTT-22, No. 6, June 1974, pp. 652–658.

Kyanite and Related Materials

By Michael J. Potter [1]

Kyanite, andalusite, and sillimanite are anhydrous aluminum silicate minerals that are alike in both composition and use patterns and have the same chemical formula, $Al_2O_3 \cdot SiO_2$. Related materials include synthetic mullite, dumortierite, and topaz, also classified as aluminum silicates, although the last two additionally contain substantial proportions of boron and fluorine, respectively. All of these kyanite-group substances have the capability of serving as raw materials for manufacturing special high-performance refractories in the high-alumina category, but there has been no record in recent years of significant utilization of either dumortierite or topaz for this purpose in the United States.

Although published statistics are not sufficiently complete to be wholly conclusive, it appears that the United States, India, and the Republic of South Africa are the leading world producers of kyanite-group minerals and that they may not be far from evenly matched in this regard. It can be presumed that the U.S.S.R. and perhaps a few other industrialized nations also produce significant quantities of these materials.

The trend toward higher performance refractories capable of sustaining an increased number of furnace heats has increased demand for these raw materials. Vigorous worldwide demand for the ingredients used in making a number of special-performance refractories continued in 1974. U.S. exports of kyanite materials in 1974 were 45% above those of 1973. Production and sales of kyanite were discontinued by E. I. du Pont de Nemours & Co., at its Trail Ridge, Fla., operation in mid-1973. There has been speculation about one company's possible interest in the use of kyanite ore as a new raw material source for alumina production.

Legislation and Government Programs.—The allowable depletion rates for kyanite, established by the Tax Reform Act of 1969 and unchanged through 1974, were 22% for domestic production and 14% for foreign operations.

The U.S. Geological Survey's Office of Minerals Exploration provides Government loans of up to 50% of approved costs for the exploration of eligible kyanite deposits; no loans for that purpose were made in 1974.

DOMESTIC PRODUCTION

Kyanite was produced in the United States in 1974 at three open pit mines: Two in Virginia and one in Georgia. Kyanite Mining Corp. operated the Willis Mountain mine in Buckingham County, Va., and the Baker Mountain mine in adjoining Prince Edward County, Va. C-E Minerals, Inc., operated the Graves Mountain mine in Lincoln County, Ga. E. I. du Pont de Nemours & Co., discontinued the production and sale of kyanite in mid-1973 at Trail Ridge, Clay County, Fla. Kyanite had been obtained at this operation as a byproduct from the recovery of titanium and zirconium minerals from a sand deposit.

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[1] Physical scientist, Division of Nonmetallic Minerals.

Domestic kyanite output in 1974, as measured by the quantity sold or used, was slightly higher in tonnage than in 1973. Specific kyanite production statistics for 1974 (as well as for all previous years since 1949) are withheld to avoid disclosure of individual company confidential data.

Synthetic mullite, produced by five companies in 1974, was 53% less in tonnage than in 1973, and 5% less in total value. The 1974 output was largely high-temperature sintered material, the average unit value of which was twice that of 1973. Electric-furnace fused mullite was produced by A. P. Green Refractories Co. at Philadelphia, Pa., Babcock & Wilcox Co. at Augusta, Ga., and the Carborundum Co. at Niagara Falls, N.Y. High-temperature sintered material was produced by Harbison-Walker Refractories Co. at Eufala, Ala., and NL Industries, Inc. at Greenup, Ky.

Table 1.—Synthetic mullite production in the United States

Year	Quantity (short tons)	Value (thousands)
1970	55,516	$8,840
1971	55,077	4,945
1972	46,389	4,080
1973	58,176	5,211
1974	27,508	4,943

CONSUMPTION AND USES

Kyanite and related materials, conforming to the established end-use pattern, were consumed in 1974 mostly in the manufacture of high-alumina or mullite-class refractories and in lesser quantities as ingredients in some ceramic compositions. Imported Indian kyanite was calcined in its natural lump form, after which it was usually separated into designated particle-size ranges for use chiefly as a grog. Domestic kyanite, already ground to minus 35–mesh as required by the flotation process used in its separation and recovery, was marketed in the raw form or after heat treatment; that is, as mullite, which was sometimes further reduced in particle size before use. In the 35- to 48-mesh range, the mineral was used mostly in monolithic refractory applications such as for high-temperature mortars or cements, ramming mixes, and castable refractories, or with clays and other ingredients in refractory compositions for making kiln furniture, insulating brick, firebrick, and a wide variety of other refractory articles. More finely ground material, minus 200-mesh for example, was used in body mixes for sanitary porcelains, wall tile, precision casting molds, and miscellaneous special-purpose ceramics.

PRICES

Engineering and Mining Journal, December 1974, listed prices for kyanite, f.o.b. Georgia, ranging from $63 to $79 per short ton in bags and $2 less per ton for bulk shipments.

Price ranges quoted for kyanite-group materials in Ceramic Industry Magazine, January 1975, were as follows:

	Per short ton
Andalusite	$30–$60
Kyanite	63–116
Mullite, calcined	82–240
Mullite, fused	160–450

The December 1974 issue of Industrial Minerals (London) quoted kyanite-group price ranges approximately equivalent (with some uncertainty due to a floating exchange rate) to the following:

	Per short ton
Andalusite, Transvaal, c.i.f. main European port	$47–$51
Kyanite, Indian, c.i.f. main European port	86
Sillimanite, Indian, natural bagged, f.o.b.	86
Sillimanite, Indian, calcined, f.o.b. Calcutta	96

FOREIGN TRADE

A substantial increase took place in the amount of kyanite-group material exported, compared with that of 1973. The total amount exported was the highest in history. The tonnage of imported material continued to be small, amounting to slightly less than that of 1973. It can be supposed that the greater part of the material currently being exported consists of mullite. It should be noted, however, that some element of uncertainty is inherent in such conclusions because the Bureau of the Census export figures, on which they are based, do not clearly distinguish synthetic mullite from some other mullite-containing materials prepared by high-temperature processing of certain bauxitic and kaolinitic minerals.

Table 2.—U.S. exports and imports for consumption of kyanite and related minerals

	1972		1973		1974	
	Quantity (short tons)	Value	Quantity (short tons)	Value	Quantity (short tons)	Value
Exports:						
Argentina	112	$7,797	257	$21,279	110	$14,028
Australia	357	26,468	7,145	266,817	12,578	656,843
Belgium-Luxembourg	2,177	140,756	1,452	276,476	1,305	97,557
Brazil	124	83,119	3,965	181,819	2,465	217,703
Canada	5,708	419,689	6,010	423,327	6,843	468,929
Colombia	312	19,399	89	5,547	210	14,656
Denmark	1,094	96,133	912	62,664	--	--
France	492	56,116	803	102,263	286	57,057
Germany, West	18,292	840,785	49,081	2,489,435	54,090	2,908,878
Guatemala	18	1,610	--	--	125	8,428
Italy	8,477	435,069	4,859	372,819	12,085	970,953
Japan	25,338	1,035,628	2,783	220,297	16,483	988,077
Mexico	1,775	118,482	2,731	192,239	4,776	366,032
Netherlands	6,561	262,610	6,449	405,806	12,159	606,341
New Zealand	--	--	369	34,697	40	3,519
Philippines	189	19,359	271	32,117	151	17,726
South Africa, Republic of	17	1,083	3,909	251,574	32	5,573
Spain	--	--	--	--	4,289	202,804
Sweden	731	42,542	811	56,761	5,365	335,787
Switzerland	--	--	--	--	84	6,851
Taiwan	9	570	--	--	66	1,896
United Kingdom	1,446	107,996	826	64,088	1,746	185,058
Venezuela	558	52,485	949	86,080	622	65,183
Other	124	19,365	48	5,788	72	5,095
Total	73,911	3,737,061	93,714	5,551,893	135,982	8,204,974
Imports:						
France	--	--	2	926	--	--
India	124	5,773	177	9,080	110	4,939
Mexico	--	--	--	--	17	2,005
Netherlands	--	--	--	--	11	620
South Africa Republic of	--	--	42	[r] 3,218	56	4,848
Total	124	5,773	221	[r] 13,224	194	12,412

[r] Revised.

WORLD REVIEW

Australia.—The revised figure of 634 tons for sillimanite production in 1972 was about 33% less than that of 1971. This decline in production was said to be largely because of increasing overburden and difficulty in tracing the ore body at both the Acacia and Belmont Quarries in the Broken Hill area of New South Wales (operated by Newbolds General Refractories Ltd.).[2] In 1973 the output of sillimanite was 708 tons.

France.—Andalusite was mined by Denain-Anzin Minéraux at Glomel, and a concentrate with 59.5% Al_2O_3 was produced. Output in 1973 increased to 8,739 tons. Eventual capacity at Glomel is scheduled to be 30,000 to 40,000 tons per year, with reserves said to be several million tons.[3]

Guyana.—Kyanite is one of several as yet little-developed industrial minerals in Guyana. Recently, there has been renewed interest in the kyanite deposits, several of which are currently considered ripe for exploration. For many years bauxite has been the most important of Guyana's mineral export commodities.[4]

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[2] Black, C. D. G. Sillimanite Minerals. Mining Annual Review (London), June 1974, p. 121.

[3] Work cited in footnote 2.

India.—Production of Indian kyanite increased from 69,977 tons in 1971 to 75,485 tons in 1972, and then decreased to 58,114 tons in 1973. Exports accounted for 43% of production in 1972 and 48% of output in 1973. Belgium, Italy, Japan, and the United Kingdom were the principal recipients of exported material in 1973. Production of sillimanite in 1972 was 4,490 tons with exports amounting to 18% of this amount. Sillimanite production in 1973 was 3,516 tons, and 26% of this amount was exported.

The Geological Survey of India (GSI) reportedly continued its investigations during 1973 to fully assess the country's sillimanite resources, particularly in the Sonapahar region. Regarding sillimanite reserve data, 1967 GSI preliminary estimates were 500,000 tons of "measured ore" (57.0% to 62.2% Al_2O_3) plus 1.5 million tons of inferred reserves (qualities unreported) in the Sonapahar and Jaintia Hills areas.[5]

The Federation of Indian Mineral Industries published a revised and updated survey entitled "Export Possibilities of Minor Minerals."[6] Kyanite and sillimanite were among the several minerals covered in the survey. World reserves, production, and trade were outlined, followed by detailed Indian production and exports. The appendix contained a list of Indian exporters.

South Africa, Republic of.—Five companies extracted andalusite in the Republic of South Africa, one of the world's leading producers. Alluvial deposits in Western Transvaal were worked by four companies, and metamorphosed shales in Eastern Transvaal were processed by one company. The andalusite output in 1973 of 66,912 tons was up 32%, compared with the 1972 figures. Over 25% of total output was exported in 1973.[7] Production of sillimanite was 21,293 tons in 1973, of which nearly 80% was exported.[8]

Sri Lanka.—A survey was completed by the Sri Lanka Geological Survey Department on the Pulmoddai mineral sands.[9] This deposit, located in the northeast of the island, has at least 3.26 million tons of heavy mineral sands in the deposit area above the low water mark. Sillimanite comprises about 1%, with ilmenite and rutile around 80%. The deposit is 4½ miles long and 100 yards wide maximum, and has no overburden. It is said to be one of the richest mineral sand deposits in the world.

United Kingdom.—Imports of kyanite-group minerals amounted to 19,825 tons in 1972. The principal countries of origin and the amounts supplied were Republic of South Africa—51%, India—28%, and France—12%. In 1973 kyanite-group imports were 35,790 tons. The principal countries of origin and the amounts supplied were Republic of South Africa—65%, India—19%, and France—11%.[10]

U.S.S.R.—Extensive deposits of kyanite ores were reportedly discovered in the Keyvy Mountains in Murmansk Oblast. Prospecting has been undertaken at 29 kyanite deposits, of which 6 have been explored. Reserves at these latter deposits are said to amount to more than 3 billion tons. Construction of a mining and concentrating complex is scheduled to begin during the next 5-year period, as are facilities for the production of aluminum alloys and refractory materials.[11]

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[4] Industrial Minerals (London). Guyana: "Thar's Industrial Minerals in Them Thar Hills!" No. 81, June 1974, p. 63.

[5] U.S. Embassy, New Delhi, India. Industrial Outlook Report. State Department Airgram A-206, May 31, 1974, pp. 64–65, 96, Appendix A, pp. 2–3, Appendix C, pp. 1–2.

[6] Industrial Minerals (London). Publications. No. 80, May 1974, p. 43.

[7] Work cited in footnote 2.

[8] Page 120 of work cited in footnote 2.

[9] Industrial Minerals (London). Sri Lanka—Pulmoddai's Mineral Sands. No. 77, February 1974, p. 27.

[10] Industrial Minerals (London). UK 1973 Mineral Imports. No. 79, April 1974, p. 44.

[11] Mining Magazine. Soviet Kyanite Find. V. 130, No. 4, April 1974, p. 281.

Table 3.—Kyanite, sillimanite, and related materials: World production by country [1]
(Short tons)

Country and commodity [2]	1972	1973	1974 [p]
Australia: Sillimanite [3]	[r] 634	708	[e] 770
India:			
Kyanite	75,485	58,114	[e] 44,000
Sillimanite	4,490	3,516	[e] 3,600
Korea, Republic of (South): Andalusite	35	91	[e] 100
Spain: Andalusite	[r] 6,063	6,173	[e] 6,200
South Africa, Republic of:			
Andalusite	50,549	66,912	70,557
Sillimanite	10,445	21,293	14,430
United States:			
Kyanite	W	W	W
Synthetic mullite	46,389	58,176	27,508

[e] Estimate. [p] Preliminary. [r] Revised. W Withheld to avoid disclosing individual company confidential data.

[1] Owing to incomplete reporting, the table has not been totaled.

[2] In addition to the countries listed, a number of other countries presumably produce kyanite and related minerals, but output data are not reported and no basis is available for estimates of output levels.

[3] In addition, sillimanite clay (also called kaolinized sillimanite) is produced, but available information is inadequate to make reliable estimates.

TECHNOLOGY

The thermal decomposition of kyanite to mullite and free silica was described.[12] A density reduction of 15% to 17% takes place, and this relatively large density differential was used to measure the degree of decomposition in two typical size fractions of commercial kyanite (minus 35- plus 50-mesh and minus 200- plus 270-mesh). Heat treatment for different lengths of time took place over the 1,200° to 1,400° C range. The main objective of this study was to use pycnometric density measurements as a quick, accurate, and inexpensive method of measuring the degree of conversion of kyanite in commercial calcining processes. In addition, the kinetics of the thermal decomposition of two size fractions of kyanite were discussed.

Kyanite ore, which normally contains between 15% and 20% alumina (Al_2O_3), is being considered as a potential alumina source in Idaho.[13] The company involved is Ethyl Corp., which has expertise in aluminum-based biodegradable detergents.

A patent was issued for the smelting of kyanite or similar material to produce aluminum or aluminum-silicon alloys.[14] Ore is heated to 1,500° to 1,800° C using coal or coke. The prereduced ore is then transferred to an electric arc furnace and heated to 2,000° to 2,300° C where conversion of silicon carbide to elemental silicon and the alumina to elemental aluminum takes place.

Another patent was issued for upgrading titanium-containing kyanite, or other aluminosilicate ores, to obtain a concentrate suitable for making aluminum-silicon alloys.[15] Finely divided ore at elevated temperatures is contacted with hexaclorobutadiene or hexachlorobenzene to drive off chlorides of titanium and iron in vapor form.

Dense mullite brick (70% alumina) is one of the ceramic and refractory materials of potential interest in coal gasification. Conversion of coal to combustible gas starts in the gasifier, which is essentially a refractory-lined steel shell. The gasifier environment places severe demands on refractory linings of the shell as well as the combustors, regenerators, cyclones, and connecting ducts. The linings must withstand the corrosiveness, erosiveness, and general reactivity of the hot, high-velocity, high-pressure, particulate-laden gas stream. Since there are no closely analagous applications, it is not known how refractories will perform in this environment.[16]

The use of plastic monolithic refractories, including mullite-based types, in kiln linings was discussed.[17] Construction is usually accomplished by pneumatically operated bench rammers. Plastic refractories are composed of crushed or ground calcined aggregate bonded with specific clays and chemicals, mixed and packaged to a specific workability to permit handling and ramming in place. The plastic construction is said to have several desirable aspects, including fuel savings.

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[12] Jain, D. C., J. J. Brown, Jr., and C. B. Kay. Thermal Decomposition of Kyanite Using Density Measurements. Am. Ceram. Soc. Bull., v. 53, No. 9, September 1974, pp. 650–653.

[13] Radcliffe, D. Industrial Minerals—Kyanite. Min. Eng., v. 27, No. 2, February 1975, p. 78.

[14] Wood, J. M., Jr. (assigned to Ethyl Corp.). Prereduction Process. U.S. Pat. 3,758,289, Sept. 11, 1973.

[15] Hildreth, C. L. (assigned to Ethyl Corp.). Method of Beneficiating Ores. U.S. Pat. 3,788,834, Jan. 29, 1974.

[16] Hall, A. M. Coal Gasification Poses Demanding Material Requirements. Mater. Eng., v. 80, No. 1, July 1974, pp. 16–18.

Chemical analysis of refractories, including mullite, by X-ray fluorescence was described.[18] Three sample preparation methods were evaluated: Pressed powders, borate fusions, and sodium-silicate melts. Mineralogical problems were encountered with pressed powders, and incomplete refractory solution was found with borate fusions. Sodium-silicate glass melts produced durable samples and reportedly the best results.

A patent was issued for the formation of mullite in clay wares.[19] Lower firing temperatures are achieved by incorporating in the clay mix about 1% to 3% of a fluorine compound, such as fluorspar or topaz. A patent for a new type of mullite brick refractory containing from 56% to 80% mullite, 6% to 13% calcined kyanite, 5% to 8% alumina, 1% to 9% silica, and 4% to 25% iron-chromite ore was granted.[20] This new refractory is said to have increased service life and decreased alkali and slag attack when used in the steel industry. A summary of the main types of refractory products, including mullite, was given.[21]

Refractory mullite was one of the materials for which mechanical and electrical properties were listed in a summary table.[22]

Phases in the kaolinite-mullite reaction sequence were reexamined by infrared absorption spectrophotometry.[23]

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[17] Bernoth, N. T. Plastic Refractories Facilitate Kiln Linings. Rock Products, v. 77, No. 5, May 1974, pp. 102–104.

[18] Winger, L. A., and E. L. McKinley. Chemical Analysis of Refractories by X-Ray Fluorescence of Glass Pellets. Am. Ceram. Soc. Bull., v. 53, No. 9, September 1974, pp. 638–640.

[19] Shutt, T. C. (assigned to Fiberglas Canada Limited). Mullite Formation. U.S. Pat. 3,761,295, Sept. 25, 1973.

[20] Manigault, E. L. (assigned to The Chas. Taylor's Sons Co.). Mullite-Chrome Refractory. U.S. Pat. 3,773,532, Nov. 20, 1973.

[21] Brick & Clay Record. Solve Industries' Hottest Problems. V. 164, No. 1, January 1974, p. 44.

[22] Materials Engineering. 1975 Materials Selector. V. 80, No. 4, Mid-September 1974, p. 289.

[23] Percival, H. J., J. F. Duncan, and P. K. Foster. Interpretation of the Kaolinite-Mullite Reaction Sequence From Infrared Absorption Spectra. J. Am. Ceram. Soc., v. 57, No. 2, February 1974, pp. 57–61.

Lead

By J. Patrick Ryan [1] and John M. Hague [1]

World mine production, which had been trending upward for several years, dropped slightly in 1974 but smelter production increased marginally from the record high level of output achieved in 1973. World metal consumption decreased about 1% but exceeded production by nearly 4%, the shortfall in production being balanced essentially by withdrawals from producers and Government stocks. The U.S. lead price advanced to a record high in 1974 following removal of price controls in December 1973. The U.S. producers average price reached 24.5 cents per pound late in June, virtually the same as the London Metal Exchange (LME) price. The average equivalent LME price exceeded the U.S. producers price during the first 8 months of the year then fell slightly below the U.S. price in the last 4 months. The average equivalent LME price in 1974 was 26.83 cents per pound. The average domestic price of lead on a nationwide basis in 1974 was 22.53 cents per pound.

Domestic mine production increased 10% in 1974 to a 47-year record high, but smelter production was slightly lower than the 43-year high level achieved in 1972. Secondary smelter output increased 7% to nearly 698,700 tons, a new record representing about 50% of total smelter and refinery production of lead.

Consumption of lead reached a record high of 1.6 million tons, nearly 4% more than in 1973. Lead requirements in the transportation field continued to grow, accounting for 69% of total lead consumption in 1974. Storage battery requirements increased 11%, more than offsetting a 9% decline in lead used in gasoline antiknock compounds. Moderate gains were recorded in the quantity of lead used in pigments and ammunition which together accounted for 13% of total consumption.

Stocks of refined lead and lead in antimonial lead at primary plants increased 43% during the year to 37,300 tons at yearend. Consumers stocks of refined soft lead and lead in antimonial lead and other alloys increased 34% to 165,400 tons at yearend.

Park City Ventures, jointly owned by The Anaconda Company and American Smelting and Refining Co. (ASARCO Inc.) continued development work and construction of a 750-ton-per-day concentrator at the Ontario zinc-lead mine, Park City, Utah. The mine is scheduled for production in April 1975.

Legislation and Government Programs.—The General Services Administration (GSA) reported that commitments to purchase surplus lead from the Government stockpile totaled 229,320 tons in 1974. Of the total about 151,230 tons represented commercial commitments through producers; the remaining 78,090 tons represented transfers for Government use and commitments under the set-aside program. The uncommitted surplus at yearend was 534,643 tons, of which 69,751 tons excess to stockpile requirements was available for disposal. Actual physical drawdown of Government stocks during 1974 was 265,676 tons, leaving a total inventory in storage of 608,654 tons on December 31. The shelf-item disposal program of direct sales to consumers and transfers for direct Government use ended on December 31, 1974. The unsold balance reverted to the long-term disposal contracts with primary domestic producers.

A bill (H.R. 14845) was introduced in the Congress to authorize the disposal of 464,900 tons of lead from the national and supplemental stockpiles. By yearend, no further action had been taken on the bill.

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Proposed regulations to phase out lead shot for water fowl hunting throughout much of the United States starting in 1976 were published in the Federal Register. Public hearings were held in four cities but a final decision had not been reached at yearend.

In October the Environmental Protection Agency (EPA) published standards of performance for new and modified sources for primary copper, lead, and zinc smelters under authority of section 111 of the Clean Air Act, as amended. The proposed standard for sulfur dioxide (SO_2) emissions was designed to reflect the degree of limitation attainable through the application of the best available technology. The basic standard for primary lead smelters would prohibit the discharge of any gases which contain more than 0.065% sulfur dioxide by volume.

On December 20 the U.S. Circuit Court of Appeals for Washington set aside the EPA regulations for a gradual phasedown of lead in gasoline by a two-to-one vote. The phasedown which was scheduled to begin on January 1, 1975, would direct that gasoline refiners reduce the average lead content of gasoline over a 4-year period from 1.7 grams per gallon after January 1, 1975, to 0.5 gram per gallon after January 1, 1979. The formal written opinion on an appeal by Ethyl Corp. and others, challenging the health aspects set forth by EPA, was issued in January 1975. The Court found that evidence did not support the EPA contention that auto emissions contributed significantly to blood lead levels in adults and children and that issuance of the EPA regulations was arbitrary and capricious.

Table 1.—Salient lead statistics

(Short tons unless otherwise specified)

	1970	1971	1972	1973	1974
United States:					
Production:					
Domestic ores, recoverable lead content	571,767	578,550	618,915	603,024	663,870
Value ______ thousands	$178,609	$159,679	$186,046	$196,465	$298,742
Primary lead (refined):					
From domestic ores and base bullion	528,086	573,022	577,398	567,256	580,078
From foreign ores and base bullion	138,644	76,993	103,001	107,260	92,946
Antimonial lead (primary lead content)	11,655	16,116	8,185	13,223	9,867
Secondary lead (lead content)	597,390	596,797	616,597	654,286	698,698
Exports of lead materials excluding scrap	7,747	5,925	8,376	66,576	61,982
Imports, general:					
Lead in ore and matte	112,406	65,998	[r] 101,282	[r] 109,947	94,299
Lead in base bullion	296	41	895	4	831
Lead in pigs, bars, and old	251,480	198,970	[r] 245,853	[r] 181,486	119,579
Stocks December 31 (lead content):					
At primary smelters and refineries	192,985	121,660	145,573	89,847	121,051
At consumer plants	133,502	125,577	118,544	124,121	166,589
Consumption of metal, primary and secondary	1,360,552	1,431,514	1,485,254	1,541,209	1,599,427
Price: Common lead, average, cents per pound[1]	15.69	13.89	15.03	16.29	22.53
World:					
Production:					
Mine	3,741,546	3,742,950	[r] 3,801,094	[r] 3,877,593	3,844,687
Smelter	3,628,422	3,590,730	[r] 3,723,409	[r] 3,796,413	3,820,544
Price: London, common lead, average, cents per pound	13.76	11.52	13.68	19.47	26.83

[r] Revised.

[1] Quotations for 1970–71 at New York and for 1972–74 on a nationwide, delivered basis.

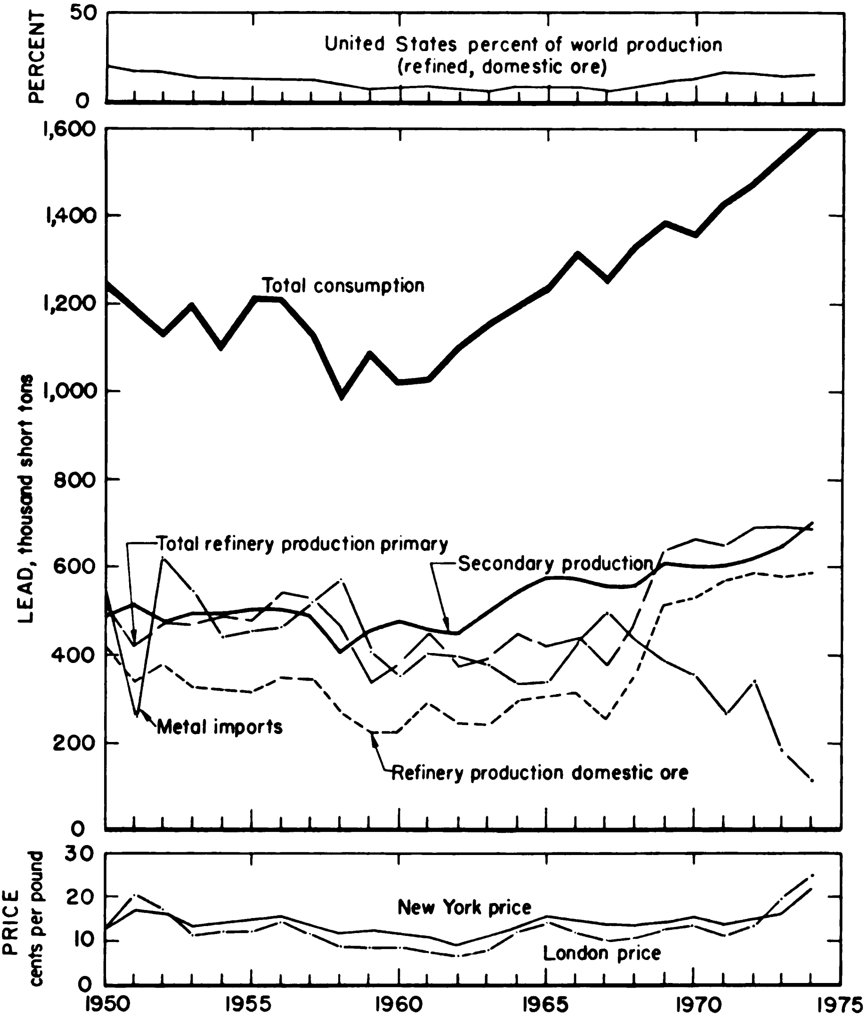

Figure 1.—Trends in the lead industry in the United States.

DOMESTIC PRODUCTION

MINE PRODUCTION

Continuing an almost uninterrupted rising trend since 1962, mine production of lead increased 10% in 1974 to nearly 663,900 tons, the highest level of output since 1927. Monthly production reached a maximum of 64,900 tons in October, nearly 9,000 tons more than the maximum achieved in 1973. Production from Missouri mines increased 15% to a record high of 562,100 tons and accounted for nearly 85% of the Nation's total. Output in Idaho, which provided 8% of the total, was down 10,000 tons from the 1973 level. Colorado's production declined 3,500 tons in 1974. Utah's output of lead continued to decline reaching the lowest level in more than 70 years. Lower production at Kennecott's Burgin mine in Utah County, the State's only lead-producing mine, was attributed to adverse operating conditions including groundwater problems and high temperatures. Kennecott's Ozark mine in Missouri achieved record production in 1974 with an output of 74,500 tons of lead in concentrates compared to 59,000 tons in 1973.[2]

The Buick mine jointly owned by Amax Lead Co. of Missouri (AMAX) and Homestake Mining Co. was the leading producer for the fourth consecutive year with an output of 1.56 million tons of ore, about the same as in 1973. However, lead concentrate production increased about 11% in 1974 to 250,600 tons.[3]

The seven leading mines, all in Missouri, contributed 80% of the total U.S. mine production of lead. The 12 leading mines produced 90%, and the 25 leading mines accounted for 99% of the total. About 5,100 persons were employed in the Nation's lead, lead-silver, and lead-zinc mines and mills in 1974. Output of lead and zinc from these mines per man-year was approximately 127 tons. Average grade of lead ore mined was 6.24% lead and 1.01% zinc compared with 6.55% lead and 1.08% zinc in 1973.

St. Joe Minerals Corp., the Nation's largest lead mining company, continued to operate its four mine-mill units in southeast Missouri and reported that 1974 production of lead in concentrate increased 43,436 tons to 247,494 tons.[4] The production gain was largely due to near-capacity operations at the corporation's new Brushy Creek mine which began operation in 1973.

Hecla Mining Co. reported that production at its Lucky Friday mine in the Coeur d'Alene district, Idaho, was 165,700 tons of ore assaying 9.93% lead, 1.18% zinc, and 13.53 ounces of silver per ton compared with 176,900 tons assaying 11.14% lead, 1.22% zinc, and 15.49 ounces of silver per ton in 1973. The decrease in mine output was attributed to a shortage of experienced underground miners. Ore reserves at Lucky Friday at yearend totaled 539,000 tons compared with 510,000 tons a year earlier. Hecla also reported that ore production at the Star-Morning mine jointly owned by Hecla (30%) and The Bunker Hill Co. (70%) increased 15,800 tons to 281,580 tons. Hecla's share of the 1974 production of lead-zinc-silver ore was 84,470 tons assaying 4.77% lead, 6.04% zinc, and 2.45 ounces of silver per ton. Hecla's share of the computed ore reserves increased 90,000 tons to 376,000 tons at yearend.[5]

In Colorado, Idarado Mining Co. treated 396,600 tons of lead-zinc-copper ore averaging 2.46% lead, 3.33% zinc and 0.55% copper compared with 378,200 tons milled in 1973 averaging 2.55% lead, 3.44% zinc, and 0.56% copper. Ore reserves at yearend 1974 increased 20% to 3.88 million tons averaging 3.13% lead, 4.41% zinc, 0.69% copper, 1.77 ounces of silver and 0.02 ounce of gold per ton. The Leadville mine (Resurrection mine) a joint venture of ASARCO and Newmont Mining Corp., milled 163,000 tons of lead-zinc-silver ore in 1974, about 43,000 tons more than in 1973. However, manpower shortages continued to retard operation of the mine at full capacity. Ore reserves at yearend were estimated at 2.65 million tons averaging 5.0% lead, 9.4% zinc, 2.4 ounces of silver and 0.07 ounce of gold per ton.[6]

Bunker Hill reported that production from company owned and controlled mines in 1974 aggregated 31,000 tons of lead, about the same as in 1973. The company also reported that proven and probable ore reserves at yearend in the Bunker Hill mine totaled 3.27 million tons averaging 2.2% lead, 3.5% zinc and 1.2 ounces of silver per ton. The company also reported that at yearend its 70% interest in proven and probable reserves in the Star mine totaled 849,500 tons averaging 6.7% lead, 7.2% zinc, and 3.8 ounces of silver per ton.[7]

SMELTER AND REFINERY PRODUCTION

Output of refined lead from the Nation's five primary refineries in 1974 dropped slightly below production in 1973 as the gain in metal recovered from domestic concentrates failed to offset a decline in metal recovered from foreign ores and concentrates. However, total primary metal production of 682,900 tons was the largest annual output since 1929. About 86% of the total output was recovered from domestic ores compared with 84% in 1973. Antimonial lead production at primary refineries declined 19% to 12,513 tons, continuing a general downward trend since 1968. The average antimony content of the alloy increased 1.3% to 8.8%, the highest level since 1967.

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[2] Kennecott Copper Corp. 1974 Annual Report. P. 11.

[3] AMAX Lead Co. 1974 Annual Report. P. 5.

[4] St. Joe Minerals Corp. 1974 Annual Report. P. 16.

[5] Hecla Mining Co. 1974 Annual Report. Pp. 6–7.

[6] Newmont Mining Corp. 1974 Annual Report. P. 6.

[7] Gulf Resources & Chemical Corp. 1974 Annual Report. P. 11.

Metal production at the Herculaneum, Mo., smelter of St. Joe Minerals Corp. reached capacity in 1974 with a production of 230,870 tons of lead metal and lead alloys, about 15,900 tons more than in 1973.[8]

ASARCO reported that lead production at its Omaha and Glover refineries, totaling 218,600 tons, was about 9% less than in 1973. The Omaha, Nebr., refinery treated base bullion essentially from the company's custom smelters at El Paso, Tex., and East Helena, Mont. Most of the concentrate treated at the Glover, Mo., smelter-refinery came from Kennecott's Ozark mine at Sweetwater, Mo. The East Helena smelter, operating at 78% of rated capacity during the year, processed ore and concentrate from about 110 domestic mines in 7 States and from mines in Canada, Peru, and Australia. The El Paso lead smelter, operating at 67% of capacity in 1974, processed ore and concentrate from approximately 36 domestic mines in 8 States and from mines in Peru, Canada, Honduras, Nicaragua, Australia, and Mexico. The smelter was closed by a strike for 5 weeks during the year. The company reported the installation of a computerized monitoring system at the Glover smelter to give early warning of increases in the sulfur dioxide content of ground-level air so that operations can be curtailed when necessary to assure compliance with State and Federal ambient air standards.[9]

The AMAX-Homestake smelter-refinery at Boss, Mo., produced 134,300 tons of refined lead, approximately one-half of which was derived from concentrates treated on toll for others.[10]

At the Bunker Hill smelter-refinery of Gulf Resources & Chemical Corp., lead production declined about 6% to 123,000 tons. The lower output was attributed largely to interruption of operations, caused by storms and a 10-day labor strike by craft unions. In addition production was curtailed occasionally during weather inversions to meet sulfur dioxide emission standards.[11] The Bunker Hill smelter processed concentrates from mines in six States and from mines in Canada and Peru.

Secondary smelter production of lead from recycled materials increased nearly 7% to a new record output of 698,700 tons, about 50% of the total smelter and refinery production. Approximately 130 secondary plants were engaged in recovery of lead and lead alloys from scrap materials during the year. Secondary metal output represented about 44% of total lead consumption in 1974. About six plants engaged in processing lead scrap closed during the year.

U.S.S. Lead Refinery, Inc., a subsidiary of U.V. Industries, Inc., expanded its facilities for processing scrap lead materials at East Chicago, Ind., which will more than double the company's production of antimonial and soft lead.

RAW MATERIAL SOURCES

Primary smelters and refineries processed ores and concentrates from domestic mines yielding 586,000 tons of refined lead and antimonial lead. This represented nearly 86% of total primary production, compared with 84% in 1973. Refined and antimonial lead recovered from imported concentrates smelted during the year amounted to 96,900 tons, about 14,600 tons less than in 1973. Lead recovered from lead scrap processed at primary plants increased to about 1,500 tons contained in antimonial lead compared with 1,100 tons in 1973.

Scrap materials consumed in 1974 totaled 929,100 tons, 61,400 tons more than in 1973. About 95 secondary smelters accounted for nearly all of the total scrap consumed. New scrap in the form of purchased drosses and residues from a wide variety of sources aggregated 129,400 tons, about 14% of the total scrap processed compared with 154,700 tons, about 18% of the total input in 1973. The remainder, old scrap, was largely battery plates, with small quantities of cable lead, type metal, solder, babbitt, and soft and hard lead.

A small amount of reclaimed scrap, totaling only 1,200 tons in 1974, was imported for processing in domestic plants.

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[8] Work cited in footnote 4.
[9] ASARCO Incorporated. 1974 Annual Report. P. 18.
[10] Work cited in footnote 3.
[11] Gulf Resources & Chemical Corp. 1974 Annual Report. Pp. 8–11.

CONSUMPTION AND USES

Domestic consumption of lead increased nearly 4% in 1974 to a new record of 1.60 million tons. On a monthly basis consumption ranged from a low of 112,800 tons in July to a new record high of nearly 157,000 tons in October. Use of lead increased in all major product sectors except chemicals (gasoline antiknock additives) which declined nearly 9% from the 1973 level and accounted for about 16% of total lead consumption. The 6% increase in the metal products sector, which accounted for 74% of the total consumption, represented gains in battery requirements and, to a lesser extent, ammunition. These gains more than offset combined losses in metal used in bearings, pipes, sheets, and solder. Changes in metal consumed in most other metal products were relatively minor. According to type of material consumed, soft refined lead represented 66% of the total consumption, antimonial lead accounted for 29%, and lead in other alloys, mainly solders and bearing metals, accounted for 4%. Lead in copper-base scrap accounted for 1% of total consumption.

Lead requirements for battery grids and oxides increased 11% and accounted for 53% of total lead consumption. The gain in battery lead consumption reflected increased demand for batteries used for power in starting, lighting, and ignition (SLI), and traction of motor vehicles, both on-the-road and off-the-road types. A total of 55.7 million SLI-type batteries was produced in 1974, 1.4 million less than in 1973. Of the total battery production, about 44.4 million were replacement, 10.1 million were original equipment, and the remainder were exported. The 9% drop in the quantity of lead used in antiknock compounds in 1974 reflected a reduction in the average lead content per gallon of gasoline from about 2.2 grams per gallon in 1973 to about 1.90 grams per gallon, and a 2.5% drop in total gasoline production.

Lead used in pigments, particularly red lead and litharge, increased 7% and accounted for 7% of the total consumption in 1974. Miscellaneous and other unclassified uses increased 6% and accounted for 3% of the total. About 5% of the total was used for ammunition. Lead used in metal products, other than battery components and ammunition, accounted for approximately 15% of total consumption.

The domestic supply of lead metal from all sources—primary and secondary production, imports for consumption, industry stock changes, and stockpile releases—totaled about 50,600 tons more than reported consumption and exports. The apparent excess supply in 1974, amounting to about 3% of reported consumption, was attributed partly to unreported consumption, incomplete export data, and stock buildup, especially by small producers and dealers that do not report to the Bureau of Mines.

LEAD PIGMENTS

Pig lead used in the production of lead oxides and pigments totaled nearly 558,000 tons, about 9% more than in 1973. The quantity of lead used in making black oxide increased 20% and accounted for 70% of the total lead in pigments. Litharge production was down 12% and accounted for 26% of the total in 1974. Most of the litharge shipments went to battery manufacturers and is included in "Other" in table 20. Litharge shipped for use in the ceramics industry increased nearly 30% constituting 29% of the total litharge shipments in 1974.

Prices.—The published price of basic carbonate white lead in carload lots, freight allowed, remained unchanged at 23.9 cents per pound, the same as in 1973. The quoted price of red lead (Pb_3O_4) 95%, in carload lots at works, was unchanged at 21–21.2 cents per pound through April, then was advanced to 26 cents in May, to 27.75 cents in June, 27.75–29.25 cents in July, and remained unchanged thereafter to yearend. The price quotation of lead silicate ($PbSiO_3$) remained unchanged at 23 cents during the year. The price quotation for commercial-grade litharge in carload lots at works remained unchanged at 21.25–22.75 cents until May when the price was increased to 22.75–25.25 cents. The price was again increased in June to 26.50–27.25 cents and to 27.25–28.75 cents in July, remaining unchanged thereafter to yearend.

The value of shipments of white lead, red lead, and litharge amounted to $89.2 million, an average of $494 per ton compared with $72.9 million and $356 per ton in 1973.

Foreign Trade.—Imports for consumption of lead pigments and compounds decreased 30% in quantity but the value increased 16% to $10 million. Litharge, which comprised 60% of the total quantity imported, decreased 40%; imports of chrome yellow, comprising 30% of the total, were 3% less than in 1973. Virtually all of the imports of litharge came from Mexico; about two-thirds of the chrome yellow came from Japan.

Exports of pigment-grade lead oxides totaled 3,390 tons valued at $1.92 million and exports of lead oxides other than pigment grade amounted to 1,680 tons valued at $1.51 million. Shipments went to 25 countries.

STOCKS

Inventories of refined and antimonial lead at primary smelters and refineries trended downward in the first 7 months of 1974 from about 26,100 tons at the beginning of the year to a low of 17,600 tons at the end of July then trended upward through the next 4 months to 24,600 tons at the end of November. In December refiner's stocks increased sharply to about 37,300 tons at yearend, indicating a gain of 11,200 tons for the year. Stocks of lead in base bullion at yearend were about 3,300 tons less than a year earlier, but the lead content of ore and matte stocks increased nearly 23,400 tons.

Stocks of lead in all forms at consumer and secondary smelting plants totaled nearly 166,600 tons at yearend, about 42,500 tons more than at yearend 1973. Refined soft lead constituted 64% of the total compared with 68% in 1973.

Stocks of refined lead, lead in antimonial lead, and lead in alloys at producers and consumers plants totaled 202,600 tons representing less than 2 months' domestic consumption. Stocks of new and old lead scrap at secondary smelters increased about 19,900 tons to 104,100 tons at yearend.

PRICES

The U.S. producer price for common and corroding-grade lead on a nationwide basis as reported by Metals Week advanced on January 4 from a split quotation of 18–19 cents to 19.0 cents per pound. In the last week of March the price was advanced again to 21.5 cents remaining unchanged until mid-June when the price quotation was split at 21.5–24.5 until June 21 when all producers quoted 24.5 cents per pound, a new record high; thereafter, the lead price remained unchanged to yearend. The weighted average monthly U.S. producer price ranging upward from 18.98 cents in January to 24.50 cents in December, indicated a 29% gain during the year. The average price for the year was 22.53 cents compared with 16.29 cents in 1973.

The London Metal Exchange (LME) cash bid price for lead in terms of U.S. currency, trended upward in the first quarter from an average of 25.62 cents per pound in January to 32.13 cents in March, declining steadily thereafter to a low of 24.17 cents in November, and rising slightly to 24.20 cents in December. The LME price exceeded the U.S. price during the first 8 months of 1974 and was near parity with the U.S. price during the last 4 months of the year. The average LME cash price for the year was 26.83 cents, based on a monthly average Sterling Exchange rate of 233.93 cents, compared with an average price of 19.47 cents, in 1973 with Sterling Exchange averaging 245.10 cents.

FOREIGN TRADE

Exports of lead metal, lead alloys, and scrap materials declined 4% in 1974 below the record high level established in 1973. Metal and alloy exports totaled nearly 62,000 tons, about 4,600 tons less than in 1973, whereas scrap outflow (59,400 tons) was only slightly less than in 1973. About 61% of the total wrought and unwrought metal exported went to west European countries; most of the remainder went to Brazil, Canada, and Japan. Nearly 38% of the scrap shipments went to

Canada and the remainder to about 22 other countries. In addition 111,200 tons of lead and zinc concentrates was exported. Nearly one-half of the concentrates was shipped to Japan; and most of the remainder went to Belgium-Luxembourg (26%), Brazil (10%), Romania (15%), Yugoslavia (4%), and Mexico (4%). The quantities of lead and zinc contained in the concentrates are not available separately.

General imports of lead materials into the United States in 1974 dropped 26% to a total of 214,700 tons valued at $92.1 million. Receipts of lead in concentrates and other unrefined materials were down 13%, and metal receipts dropped 34% from the 1973 level of imports to about 118,400 tons, the smallest quantity of metal imported since 1946. As in 1973 the decline in lead imports in 1974 was attributed partly to the effect of the lead dumping determination by the International Trade Commission against Canadian and Australian exporters. Metal receipts from Australia and Canada were approximately 42,000 and 22,000 tons, respectively, less than in 1973.

Peru was again the leading supplier of crude lead materials with nearly 28% of the total imports; shipments from Australia, Canada, Honduras, and Mexico accounted for most of the remainder. Canada, Peru, and Mexico together furnished 92% of the total metal imported.

WORLD REVIEW

Mine production of lead in 1974 in market economy countries of the world, based on data compiled by the Bureau of Mines, totaled 2.71 million tons, about 8% less than in 1973. Mine production in centrally controlled economy countries, including Yugoslavia, was estimated to be 1.13 million tons, 29.5% of the total world production of 3.84 million tons. Smelter production of lead in market economy countries, limited to primary metal where possible, totaled 2.64 million tons and the output from centrally controlled economy countries was estimated to be 1.18 million tons yielding a world total of 3.82 million tons. Compared with 1973, the 1974 world mine production showed an 0.8% decline, whereas the world smelter production registered a 0.6% gain.

The United States increased its lead as the country producing the most lead from mine sources, accounting for 17% of the world total. Other countries producing over 100,000 tons of lead in mined ore were the U.S.S.R., Australia, Canada, Mexico, Peru, Yugoslavia, Bulgaria, North Korea, and the People's Republic of China, in descending order of quantity mined. The North American continent produced 1.29 million tons or 34% of the world total.

The United States again was the leading producer of primary lead metal. The U.S.S.R. probably ranked second, followed by Australia, Mexico, Japan, France, Yugoslavia, Canada, West Germany, Bulgaria, the People's Republic of China, North Korea, and Belgium. Each of the 13 countries produced over 100,000 tons of lead and collectively they accounted for 79% of the 1974 world production. The smelter output data for Yugoslavia, Bulgaria, and Belgium may include recovery from secondary materials.

Data released by the International Lead and Zinc Study Group (ILZSG) on consumption of refined lead in market economy countries estimated a total of 4.07 million tons in 1974, about 0.2% more than the final figure for 1973. The greatest increase was in the United States which accounted for 37% of world market economy consumption; France, West Germany, Japan, and the United Kingdom registered decreases in consumption in 1974. ILZSG reports of world lead metal production showed a deficit in supply of 130,000 tons in 1974 probably accounted for by combined changes in producers stocks and the U.S. Government stockpile.

Australia.—Due to reduced output from Broken Hill mines, mine production of lead in 1974 was 7% below that of the previous year and totaled 415,900 tons. The Zinc Corporation (ZC) and New Broken Hill Consolidated (NBHC) mines were handicapped by delays in development brought on by caving in stopes of the NBHC mine in 1973, by labor disputes, and a shortage of manpower. Nonetheless Australia remained the world's third ranking lead-producing country.

The combined production of refined lead

and lead bullion within Australia was 374,800 tons, about the same output as in 1973. Broken Hill Associated Smelters, Pty. Ltd., a subsidiary of Conzinc Riotinto of Australia, Ltd., at Port Pirie produced 222,600 tons of refined lead. Mount Isa Mines Ltd., 49% owned by ASARCO, at Mount Isa produced 139,200 tons of lead in unrefined products during fiscal 1973–74; and Sulphide Corp., Pty. Ltd., a subsidiary of Conzinc Riotinto produced 27,500 tons of lead bullion for refining elsewhere.

Consumption of primary lead in Australia declined about 4% in 1974 from the record level of 1973. Batteries, using metal and oxides, accounted for 48% of the total 54,100 tons of primary lead consumption. Total lead consumption was estimated to be 92,600 tons including refined pig lead and lead content of antimonial lead.

Canada.—Mine production of lead contained in ores and concentrates was below normal capacity in 1974 and decreased 15% from the 1973 output to about 365,000 tons. Production of primary refined metal dropped from 206,000 tons in 1973 to 138,000 tons in 1974. Strikes or lockouts at mines operated by Cyprus-Anvil Mining Corp., Brunswick Mining & Smelting Co. Ltd., and Cominco, Ltd., reduced mine production, and a 4-month strike at Cominco's Trail, British Columbia, plant cut refined metal production.

As a result of a U.S. International Trade Commission finding of injury from lead imports, shipments of lead to the United States from Canada were reduced to avoid penalties for dumping. Exports of refined lead worldwide decreased 37% to 79,050 tons, with 40% going to the United Kingdom and 39% to the United States. Exports of concentrates were maintained at a high level, totaling 213,900 tons of contained lead; 58% went to Japan, 13% to the United States, 10% to West Germany, and the balance to other European countries and Brazil. Consumption of primary metal within Canada was estimated at 75,000 tons in 1974. Secondary recovery was about 38,000 tons in 1974. Imports of refined lead in 1974 were 12,500 tons mostly from Japan and the United States.

The Yukon Territory provided the largest share of lead mine production with 32% of the total; Northwest Territories ranked second with 27%; British Columbia, 18%; New Brunswick, 15%; Newfoundland, 4%; Ontario, 3%; and three other provinces 1% of the total.

One of the two largest mine sources of lead was the Faro operation of Cyprus-Anvil Mining Corp. in Yukon Territory. This open pit mine and concentrator produced over 96,000 tons of lead in concentrates in 1974 from an ore body estimated to contain 63 million tons averaging 3.40% lead, 5.72% zinc and 1.19 ounces of silver per ton.

The second largest lead mine was operated by Pine Point Mines Ltd., a subsidiary of Cominco, Ltd., located at Pine Point in Northwest Territories. The estimated lead production in 1974 was about 90,000 tons. Ore reserves reported at the end of 1974 were 40 million tons averaging 7.8% combined zinc and lead; in past years the lead content has been about one-third of the combined assay. Cominco also produced concentrates containing about 60,000 tons of lead from the Sullivan mine in British Columbia.

Brunswick Mining & Smelting Corp. Ltd., owned 64% by Noranda Mines Ltd., produced 44,200 tons of lead from its mines near Bathurst and its smelter at Belledune, New Brunswick.

Greenland.—The Black Angel mine at latitude 71° N. successfully completed its first full year of production yielding 634,000 tons of ore containing 111,000 tons of zinc and 32,000 tons of lead. Greenex A/S, 62% owned by Cominco, Ltd., is the operating company in this territory of Denmark. Ore reserves were reported as 3.86 million tons with 15.7% zinc content and 5.1% lead content. Lead and zinc concentrates were sold to western European smelters mainly on the British market.

Honduras.—Rosario Resources Corp. reported that the El Mochito mine had the best year in its history. The company reported that production in 1974 from 328,000 tons of ore yielded 22,700 tons of lead, 25,600 tons of zinc and over 3 million ounces of silver. Total ore reserves in the area were increased to 5.8 million tons with an average grade of 5.10% lead, 8.60% zinc, 0.26% copper and 5.73 ounces of silver per ton. Rosario participated in a joint exploration venture with ASARCO Inc. to explore the old Rosario mine in depth.

Ireland.—Construction and development work at the Navan mine were suspended by Tara Exploration and Development Co. Ltd., in August 1974 because terms of the proposed State Mining Lease offered by the Irish Government were unacceptable. During the suspension, negotiations continued and agreement on a revised lease was announced in February 1975. As a result of the delay and of world-wide inflation, the estimated capital cost of the project was increased from $87 million (in 1973) to $150 million (in early 1975). Prior to the shutdown, 95,000 tons of development ore estimated to grade 11.4% zinc and 2.4% lead was stockpiled on the surface. The mine and concentrator were being designed to treat about 2.5 million tons of ore annually.

Mogul of Ireland, Ltd., a subsidiary of International Mogul Mines Ltd., operated its mine near Silvermines in County Tipperary and reported production of 23,600 tons of lead concentrate and 96,300 tons of zinc concentrate. Ore reserves were estimated at 8,470,000 tons averaging 2.75% lead and 6.48% zinc.

Irish Base Metals Ltd., a subsidiary of Northgate Exploration Ltd., operated the Tynagh mine in County Galway and produced concentrates containing 26,500 tons of lead, 19,700 tons of zinc and 870,000 ounces of silver in 1974.

Mexico.—Lead mine production increased 22% from 1973 to 1974 to a total of 240,300 tons. Industrial Minera Mexico, S.A. had a lead output of 108,200 tons and Industrias Peñoles S.A. reported production of 107,000 tons. Only 15,000 tons of lead in concentrates were produced for export by Mexican mines. Industrial Minera was modernizing its lead smelter in Chihuahua to achieve a capacity of 130,000 tons per year by 1976. Met-Mex Peñoles, S.A., a subsidiary of Industrias Peñoles, continued making improvements to the sintering, sulfuric acid, and refining plants at Torreón, designed to increase capacity to 190,000 tons per year and reduce atmospheric pollution.

In April 1974, ASARCO sold part of its equity in Industrial Minera Mexico (formerly Asarco Mexicana S.A.) to Mexican investors reducing its residual ownership to 34% of the outstanding stock.

Morocco.—Lead was the second most important mineral export of Morocco (after phosphate rock), even though production dropped 20% by metal weight, or 11% by concentrate weight, to 141,000 tons of concentrates in 1974. The largest lead mine located at Zeida maintained the same level of production as in 1973, producing 40,000 tons of concentrate. Three other mines, at Touissit, Aouli, and Aoum, had decreased activity due either to a strike or depletion of reserves in the older parts of the mine.

Discussions with the U.S.S.R. for geological studies in the northern Rif Mountains concentrated on exploration for lead and zinc in this region. A new lead smelter was planned for the Meknes area to accommodate the production of several small mines.

Peru.—With a mine production of 224,900 tons of recoverable lead, Peru ranked sixth among lead-producing nations in 1974. This output was used to produce 88,850 tons of refined lead with most of the balance exported as concentrates. The lead exported from Peru included 26,200 tons in lead concentrates and 40,000 tons of lead metal shipped to the United States.

At the El Povenir mine, Cía, Minera Milpo was expanding capacity from 1,000 to 1,800 tons of ore per day, and was planning to increase lead concentrate production to 22,000 tons per year. El Porvenir ore averaged 4.3% lead, 6% zinc, and 5 ounces of silver per ton.

The Santander mine of the St. Joe Minerals Corp. continued development to convert from the former open pit operation to a completely underground operation using trackless mining equipment on three new levels. Production of lead concentrate was at the rate of 10,000 tons per year.

Spain.—Spanish lead production was expected to increase by 40,000 tons per year within the next few years. The Rubiales zinc-lead mine in the province of Lugo in northwestern Spain was scheduled for development in 1975 and initial production by 1977. The principal shareholders were Cominco Europe N.V., 47.5%; Union Corp. (Luxembourg) S.A., 27%; and Dugwill Pty., Ltd., Asturiana de Zinc S.A., and Banco Urquijo S.A. sharing the balance. At full production the Rubiales mine will have an annual production of 16,500 tons of lead concentrate and 126,000 tons of zinc concentrate. Another zinc-lead development project, the d'Aznacollar mining complex of d'Aznacollar d'Andaluza de Piritas S.A. (APIRSA) was started during 1974 with full production of 42,000 tons of lead concentrate and 98,000 tons of zinc concentrate expected by 1978. A zinc-lead mine being developed by Asturiana at Huelva was due to reach capacity in 1975 producing 3,300 tons of lead and 7,700 tons of zinc. A new lead smelter was planned at Linares to be built by a consortium of Cía. La Cruz, Cie. Royale Asturienne des Mines S.A., EN Adaro, Société Minière et Metallurgique de Peñarroya and Cia. Minero Metallúrgica Los Guindos S.A.

Yugoslavia.—Trepča Enterprises continued to work toward increased lead and zinc mine capacity by renovating or developing five mines in Serbia and one mine in Montenegro. The concentrates are to go to the Trepča at Zvečan. Two new lead and zinc mines were planned in Macedonia with a total capacity of 1.5 million tons of ore per year. Concentrates from the Macedonia mines will be processed in the smelter at Titov Veles.

TECHNOLOGY

The International Lead Zinc Research Organization (ILZRO) reported that batteries and environmental health were the principal areas of its research activities in 1974. Fundamental research in the battery area to improve technology was directed toward obtaining a better understanding of the mechanisms of active material shedding in the positive electrodes of the lead-acid system, effects of minor constituents in the system, the effect of aging of grids on anodic corrosion, and new approaches to paste mixing. The basic thrust of fundamental research conducted in cooperation with the U.S. Naval Research Laboratory (NRL) was to improve efficiency and power density of the lead-acid battery as well as to determine the active material softening failure mechanism of the PbO_2 electrode.

ILZRO research in the environmental health area included investigations of population and occupational exposures to lead. Studies completed on a large group of workers employed in lead production facilities or battery plants over a 23-year period disclosed that the life expectancy of lead workers is approximately the same as that of all U.S. males. A study conducted in Tokyo, Japan of policemen exposed to low concentrations of lead in areas of heavy traffic concluded that at the present level of lead in air in Tokyo, no direct relationship between lead levels in blood and urine could be established.

Other ILZRO lead research was directed toward developing new low-cost alloys for the electric power industry, improved methods of splicing cable sheathing, fundamental work in the ceramics area, and field evaluation of synthesized organolead compounds.

Gould Inc. announced that it had developed a new heavy-duty battery, impervious to vibration, that operated corrosion free and required no water. The lead-calcium, maintenance-free battery retains its charge 6 to 8 times longer than ordinary batteries and has up to 30% more cranking power.

The transition to lead-calcium instead of lead-antimony grids will have an economic effect on secondary lead smelters as the antimony profit will be largely lost when large volumes of battery scrap are recycled.

Bureau of Mines engineers at Spokane, Wash., completed a comprehensive study of the Nation's primary lead resources to determine the degree of U.S. self-sufficiency in lead. Costs of producing lead from various known resources were developed by the engineers to define the future availability of lead at various price levels. The study concluded that the United States can be self-sufficient and meet demands for lead for over 100 years at current rates of consumption. Seventy-five percent (60 million tons) of the available lead is estimated to be recoverable at prices under 20 cents per pound, and 90% of the total (72 million tons) is recoverable at prices under 50 cents.[12]

Research metallurgists at the Bureau of Mines laboratory in Reno, Nev., reported that promising results were obtained in applying chlorine-oxygen leaching to recover metals from complex sulfide concentrates which cannot be processed by smelting. Lead and silver in these concentrates were converted to insoluble forms and subsequently recovered from the leach residue by hot brine leaching and precipitation as lead chloride. High-purity lead was produced by fused-salt electrolysis.

Bureau metallurgists also developed a

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[12] McIlroy, P., J. S. Coffman, W. L. Rice, and M. H. Hibpshman. Availability of U.S. Primary Lead Resources. BuMines IC 8646, 1974, 60 pp.

method of processing galena concentrates without SO_2 or lead emissions by leaching with brine solution containing $FeCl_3$. Over 99% of the lead was converted to $PbCl_2$ in bench-scale tests, while sulfur was changed to the elemental form. The $PbCl_2$ was electrolyzed in a fused-salt cell to obtain lead metal meeting ASTM standards. Efforts to scale up the process and develop an efficient demonstration cell continued.

Table 2.—Mine production of recoverable lead in the United States, by State
(Short tons)

State	1970	1971	1972	1973	1974
Alaska	--	--	--	6	--
Arizona	285	859	1,763	763	1,059
California	1,772	2,284	1,153	44	35
Colorado	21,855	25.746	31,346	28,112	24,609
Idaho	61,211	66,610	61,407	61,744	51,717
Illinois	1,532	1,238	1,335	541	493
Kansas	80	--	--	--	--
Maine	--	--	85	204	279
Missouri	421,764	429,634	489,397	487,143	562,097
Montana	996	615	287	176	154
Nevada	364	111	(1)	--	1,785
New Mexico	3,550	2,971	3,582	2,556	2,364
New York	1,280	877	1,089	2,304	3,076
Oklahoma	797	--	--	--	W
Oregon	(1)	--	--	--	W
South Dakota	3	--	--	--	--
Utah	45,377	38,270	20,706	13,733	10,510
Virginia	3,356	3,386	3,441	2,637	3,106
Washington	6,784	5,177	2,567	2,217	1,299
Wisconsin	761	752	757	844	1,285
Other States	--	20	--	--	2
Total	571,767	578,550	618,915	603,024	663,870

W Withheld to avoid disclosing individual company confidential data; included in "Other States."
[1] Less than ½ unit.

Table 3.—Production of lead and zinc in the United States in 1974, by State and class of ore, from old tailings, etc., in terms of recoverable metals

(Short tons)

State	Lead ore			Zinc ore			Lead-zinc ore		
	Gross weight (dry basis)	Lead content	Zinc content	Gross weight (dry basis)	Lead content	Zinc content	Gross weight (dry basis)	Lead content	Zinc content
Arizona	712	32	1	667	--	47	4,903	546	941
California	217	25	--	--	--	--	800	1	5
Colorado	3,110	34	--	195,563	2,143	17,213	464,300	12,653	21,385
Idaho	190,000	18,446	1,607	10,021	10	437	1,037,704	32,404	36,853
Illinois	--	--	--	--	--	--	--	--	--
Maine	--	--	--	206,404	279	10,425	--	--	--
Missouri	9,110,057	562,097	91,987	--	--	--	--	--	--
Montana	289	34	6	792	4	26	200	5	6
Nevada	2,270	47	10	50	--	1	301,688	1,725	3,393
New Jersey	--	--	--	196,499	--	32,848	--	--	--
New Mexico	16	2	--	168,657	2,120	13,262	9,713	242	292
New York	--	--	--	1,231,833	3,076	93,077	--	--	--
Pennsylvania	--	--	--	415,568	--	20,288	--	--	--
Tennessee	--	--	--	3,093,382	--	82,182	--	--	--
Utah	--	--	--	--	--	--	163,022	10,509	12,617
Virginia	--	--	--	619,760	3,106	17,195	--	--	--
Washington	--	--	--	5,000	1	107	(1)	(1)	(1)
Wisconsin	--	--	--	443,652	1,285	8,737	--	--	--
Other States	--	--	--	--	--	--	--	--	--
Total	9,306,671	580,717	93,611	6,587,848	12,024	295,845	1,982,330	58,085	75,492
Percent of total lead-zinc	--	87	19	--	2	59	--	9	15

State	Copper-lead, copper-zinc, and copper-lead-zinc ores			All other sources[2]			Total		
	Gross weight (dry basis)	Lead content	Zinc content	Gross weight (dry basis)	Lead content	Zinc content	Gross weight (dry basis)	Lead content	Zinc content
Arizona	92,820	35	8,691	59,384,767	446	19	59,483,869	1,059	9,699
California	--	--	--	4,474	9	3	5,491	35	8
Colorado	396,600	8,269	10,173	129,263	1,510	718	1,188,836	24,609	49,489
Idaho	--	--	--	440,576	857	572	1,678,301	51,717	39,469
Illinois	--	--	--	--	493	4,104	--	493	4,104
Maine	--	--	--	--	--	--	206,404	279	10,425
Missouri	--	--	--	--	--	--	9,110,057	562,097	91,987
Montana	12	1	1	21,177	110	97	22,470	154	136
Nevada	--	--	--	1,730,997	13	1	2,035,005	1,785	3,405
New Jersey	--	--	--	--	--	--	196,499	--	32,848
New Mexico	--	--	--	3,318,859	--	230	3,497,245	2,364	13,784
New York	--	--	--	--	--	--	1,231,833	3,076	93,077
Pennsylvania	--	--	--	--	--	--	415,568	--	20,288
Tennessee	1,153,085	--	3,489	--	--	--	4,246,417	--	85,671
Utah	--	--	--	29	1	2	163,051	10,510	12,619
Virginia	--	--	--	--	--	--	619,760	3,106	17,195
Washington	--	--	--	[1]270,476	[1]1,298	[1]6,802	275,476	1,299	6,909
Wisconsin	--	--	--	--	--	--	443,652	1,285	8,737
Other States	--	--	--	6,198	2	23	6,198	2	23
Total	1,642,467	8,305	22,354	65,306,816	4,739	12,571	84,826,132	663,870	499,873
Percent of total lead-zinc	--	1	4	--	1	3	--	100	100

[1] Lead-zinc ore and ore from "Other sources" combined to avoid disclosing individual company confidential data.

[2] Lead and zinc recovered from copper, gold, silver, and fluorspar ores, and from mill tailings and miscellaneous cleanups.

Table 4.—Mine production of recoverable lead in the United States, by month

(Short tons)

Month	1973	1974	Month	1973	1974
January	53,462	57,149	August	55,662	58,670
February	49,958	52,785	September	51,394	49,975
March	45,302	57,956	October	53,748	64,919
April	40,056	52,297	November	49,006	53,222
May	55,934	53,348	December	53,205	53,902
June	43,907	54,884			
July	51,395	54,763	Total	603,024	663,870

Table 5.—Twenty-five leading lead-producing mines in the United States in 1974, in order of output

Rank	Mine	County and State	Operator	Source of lead
1	Buick	Iron, Mo	AMAX Lead Co. of Missouri	Lead ore.
2	Fletcher	Reynolds, Mo	St. Joe Minerals Corp	Do.
3	Ozark	do	Ozark Lead Co	Do.
4	Magmont	Iron, Mo	Cominco American, Inc	Do.
5	Brushy Creek	Reynolds, Mo	St. Joe Minerals Corp	Do.
6	Viburnum No. 29	Washington, Mo	do	Do.
7	Viburnum No. 28	Iron, Mo	do	Do.
8	Bunker Hill	Shoshone, Idaho	The Bunker Hill Co	Lead-zinc ore.
9	Lucky Friday	do	Hecla Mining Co	Lead ore.
10	Star Unit	do	do	Lead-zinc ore.
11	Indian Creek No. 32	Washington, Mo	St. Joe Minerals Corp	Lead ore.
12	Viburnum No. 27	Crawford, Mo	do	Do.
13	Burgin	Utah, Utah	Kennecott Copper Corp	Lead-zinc ore.
14	Idarado	Ouray and San Miguel, Colo.	Idarado Mining Co	Copper-lead-zinc ore.
15	Indian Creek No. 23	Washington, Mo	St. Joe Minerals Corp	Lead ore.
16	Leadville	Lake, Colo	American Smelting and Refining Co.	Lead-zinc and lead-zinc-copper ores.
17	Sunnyside	San Juan, Colo	Standard Metals Corp	Lead-zinc ore.
18	Austinville and Ivanhoe	Wythe, Va	The New Jersey Zinc Co	Zinc ore.
19	Balmat	St. Lawrence, N. Y.	St. Joe Minerals Corp	Do.
20	Camp Bird	Ouray, Colo	Federal Resources Corp	Lead-zinc ore.
21	Eagle	Eagle, Colo	The New Jersey Zinc Co	Zinc ore.
22	Ground Hog	Grant, N. Mex	American Smelting and Refining Co.	Do.
23	Dayrock	Shoshone, Idaho	Day Mines, Inc	Lead ore.
24	Pan American	Lincoln, Nev	St. Patrick Mining Co. Inc	Lead-zinc ore.
25	Bulldog Mountain	Mineral, Colo	Homestake Mining Co	Silver ore.

Table 6.—Refined lead produced at primary refineries in the United States, by source material

(Short tons)

	1970	1971	1972	1973	1974
Refined lead:[1]					
From primary sources:					
Domestic ores and base bullion	528,086	573,022	577,398	567,256	580,078
Foreign ores and base bullion	138,644	76,993	103,001	107,260	92,946
Total	666,730	650,015	680,399	674,516	673,024
From secondary sources	4,367	1,223	1,189	--	--
Grand total	671,097	651,238	681,588	674,516	673,024
Calculated value of primary refined lead (thousands)[2]	$209,220	$180,574	$204,528	$219,757	$303,265

[1] GSA metal is not included in refined lead production.

[2] Value based on average quoted price and excludes value of refined lead produced from scrap at primary refineries.

Table 7.—Antimonial lead produced at primary lead refineries in the United States

Year	Production (short tons)	Antimony content		Lead content by difference (short tons)			
		Short tons	Percent	From domestic ore	From foreign ore	From scrap	Total
1970	20,438	1,184	5.8	8,826	2,829	7,599	19,254
1971	19,686	1,191	6.0	12,247	3,869	2,379	18,495
1972	15,051	1,050	7.0	6,136	2,049	5,816	14,001
1973	15,455	1,167	7.5	9,020	4,203	1,065	14,288
1974	12,513	1,097	8.8	5,879	3,988	1,549	11,416

Table 8.—Stocks and consumption of new and old lead scrap in the United States in 1974

(Short tons, gross weight)

Class of consumers and type of scrap	Stocks Jan. 1	Receipts	Consumption			Stocks Dec. 31
			New scrap	Old scrap	Total	
Smelters and refineries:						
Soft lead	2,007	33,814	--	33,641	33,641	2,180
Hard lead	656	56,571	--	54,778	54,778	2,449
Cable lead	1,335	46,801	--	45,507	45,507	2,629
Battery-lead plates	54,225	619,016	--	614,364	614,364	58,877
Mixed common babbitt	434	5,948	--	5,984	5,984	398
Solder and tinny lead	1,190	12,999	--	13,663	13,663	526
Type metals	2,208	26,464	--	25,745	25,745	2,927
Drosses and residues	21,999	141,560	129,400	--	129,400	34,159
Total	84,054	943,173	129,400	793,682	923,082	104,145
Foundries and other manufacturers:						
Soft lead	--	--	--	--	--	--
Hard lead	--	--	--	--	--	--
Cable lead	--	--	--	--	--	--
Battery-lead plates	--	--	--	--	--	--
Mixed common babbitt	239	5,804	--	6,041	6,041	2
Solder and tinny lead	--	--	--	--	--	--
Type metals	--	--	--	--	--	--
Drosses and residues	--	--	--	--	--	--
Total	239	5,804	--	6,041	6,041	2
All consumers:						
Soft lead	2,007	33,814	--	33,641	33,641	2,180
Hard lead	656	56,571	--	54,778	54,778	2,449
Cable lead	1,335	46,801	--	45,507	45,507	2,629
Battery-lead plates	54,225	619,016	--	614,364	614,364	58,877
Mixed common babbitt	673	11,752	--	12,025	12,025	400
Solder and tinny lead	1,190	12,999	--	13,663	13,663	526
Type metals	2,208	26,464	--	25,745	25,745	2,927
Drosses and residues	21,999	141,560	129,400	--	129,400	34,159
Grand total	84,293	948,977	129,400	799,723	929,123	104,147

Table 9.—Secondary metal recovered[1] from lead and tin scrap in the United States in 1974, by type of product

(Short tons)

	Lead	Tin	Antimony	Other	Total
Refined pig lead	189,002	--	--	--	189,002
Remelt lead	49,214	--	--	--	49,214
Total	238,216	--	--	--	238,216
Refined pig tin	--	1,990	--	--	1,990
Remelt tin	--	239	--	--	239
Total	--	2,229	--	--	2,229
Lead and tin alloys:					
Antimonial lead	371,503	803	18,963	451	391,720
Common babbitt	12,469	503	1,253	1	14,226
Genuine babbitt	21	125	10	4	160
Solder	26,783	5,863	743	43	33,432
Type metals	20,758	1,088	2,484	--	24,330
Cable lead	12,551	--	105	--	12,656
Miscellaneous alloys	616	41	12	78	747
Total	444,701	8,423	23,570	577	477,271
Tin content of chemical products		661	--	--	661
Grand total	682,917	11,313	23,570	577	718,377

[1] Most of the figures herein represent actual reported recovery of metal from scrap.

Table 10.—Secondary lead recovered in the United States

(Short tons)

	1970	1971	1972	1973	1974
As metal:					
At primary plants	4,367	1,223	1,189	--	--
At other plants	154,800	148,911	172,168	186,124	238,216
Total	159,167	150,134	173,357	186,124	238,216
In antimonial lead:					
At primary plants	7,599	2,379	5,816	1,065	1,549
At other plants	340,759	340,333	340,066	374,173	369,954
Total	348,358	342,712	345,882	375,778	371,503
In other alloys	89,865	103,951	97,358	92,384	88,979
Grand total:					
Quantity	597,390	596,797	616,597	654,286	698,698
Value (thousands)	$187,461	$165,790	$185,349	$213,166	$314,833

Table 11.—Lead recovered from scrap processed in the United States, by kind of scrap and form of recovery

(Short tons)

Kind of scrap	1973	1974	Form of recovery	1973	1974
New scrap:			As soft lead:		
Lead-base	110,787	92,680	At primary plants	--	--
Copper-base	4,506	4,792	At other plants	186,124	238,216
Tin-base	403	281	Total	186,124	238,216
Total	115,696	97,753	In antimonial lead[1]	375,778	371,503
Old scrap:			In other lead alloys	75,545	72,597
Battery-lead plates	369,819	418,400	In copper-base alloys	16,805	16,361
All other lead-base	153,938	169,184	In tin-base alloys	34	21
Copper-base	14,831	13,359			
Tin-base	2	2	Total	468,162	460,482
Total	538,590	600,945	Grand total	654,286	698,698
Grand total	654,286	698,698			

[1] Includes 1,065 tons of lead recovered in antimonial lead from secondary sources at primary plants in 1973 and 1,549 tons in 1974.

Table 12.—Lead consumption in the United States, by product

(Short tons)

Product	1973	1974	Product	1973	1974
Metal products:			Pigments—Continued:		
Ammunition	81,479	87,090	Pigment colors	16,963	17,336
Bearing metals	15,657	14,609	Other[1]	477	718
Brass and bronze	22,735	22,240			
Cable covering	43,005	43,426	Total	108,766	116,213
Calking lead	20,057	19,739			
Casting metals	7,220	7,507	Chemicals:		
Collapsible tubes	2,860	2,488	Gasoline antiknock additives	274,410	250,502
Foil	4,985	4,404	Miscellaneous chemicals	944	708
Pipes, traps, and bends	21,291	16,455			
Sheet lead	23,394	21,294	Total	275,354	251,210
Solder	71,770	66,280			
Storage batteries:			Miscellaneous uses:		
Battery grids, posts, etc.	365,557	391,479	Annealing	3,974	4,097
			Galvanizing	1,294	1,664
Battery oxides	403,890	460,402	Lead plating	744	498
Terne metal	2,658	2,300	Weights and ballast	20,848	21,418
Type metal	21,922	20,516			
			Total	26,860	27,677
Total	1,108,480	1,180,229	Other, unclassified uses	21,749	24,098
Pigments:			Grand total[2]	1,541,209	1,599,427
White lead	1,749	1,996			
Red lead and litharge	89,577	96,163			

[1] Includes lead content of leaded zinc oxide and other pigments.

[2] Includes lead which went directly from scrap to fabricated products.

Table 13.—Lead consumption in the United States, by month

(Short tons)

Month	1973	1974	Month	1973	1974
January	135,308	140,971	August	125,707	143,953
February	131,695	129,404	September	124,793	143,712
March	143,197	130,884	October	140,655	156,780
April	128,432	126,500	November	131,420	136,434
May	128,776	142,615	December	120,208	113,842
June	129,124	121,530			
July	101,894	112,802	Total[1]	1,541,209	1,599,427

[1] Includes lead which went directly from scrap to fabricated products and lead contained in leaded zinc oxide and other pigments.

Table 14.—Lead consumption in the United States in 1974, by class of product and type of material

(Short tons)

Product	Soft lead	Lead in antimonial lead	Lead in alloys	Lead in copper-base scrap	Total
Metal products	181,205	64,121	67,702	15,320	328,348
Storage batteries	475,619	376,220	42	--	851,881
Pigments	116,127	86	--	--	116,213
Chemicals	251,093	117	--	--	251,210
Miscellaneous	13,432	14,231	14	--	27,677
Unclassified	21,942	1,146	1,010	--	24,098
Total	1,059,418	455,921	68,768	15,320	[1] 1,599,427

[1] Includes lead which went directly from scrap to fabricated products and lead contained in leaded zinc oxide and other pigments.

Table 15.—Lead consumption in the United States in 1974, by State[1]

(Short tons)

State	Refined soft lead	Lead in antimonial lead	Lead in alloys	Lead in copper-base scrap	Total
California	113,333	47,177	4,177	690	165,377
Colorado	1,231	1,153	58		2,442
Connecticut	9,585	9,160	--	1,332	20,077
District of Columbia	131	--	--	--	131
Florida	10,032	8,534	--	--	18,566
Georgia	50,936	24,588	268	--	75,792
Illinois	95,048	42,253	9,653	1,580	148,534
Indiana	145,259	52,688	3,317	308	201,572
Kansas	16,748	14,527	30	214	31,519
Kentucky	6,812	11,653	2	--	18,467
Maryland	815	3,296	2,632	19	6,762
Massachusetts	2,265	279	12	290	2,846
Michigan	11,247	14,815	2,996	52	29,110
Missouri	31,877	9,511	1,666	1,207	44,261
Nebraska	3,469	1,220	1,468	1,434	7,591
New Jersey	115,427	20,693	4,890	683	141,693
New York	50,860	4,264	11,081	416	66,621
Ohio	10,623	4,929	3,821	1,961	21,334
Pennsylvania	75,367	56,869	16,102	2,219	150,557
Rhode Island	3,676	344	--	--	4,020
Tennessee	3,481	19,617	112	87	23,297
Virginia	619	2,696	1,189	1,097	5,601
Washington	15,371	649	--	--	16,020
West Virginia	18,266	438	--	--	18,704
Wisconsin	6,115	9,719	84	356	16,274
Alabama and Mississippi	6,949	6,644	--	455	14,048
Arkansas and Oklahoma	4,154	6,324	73	--	10,551
Hawaii and Oregon	5,538	6,935	1	--	12,474
Iowa and Minnesota	9,625	14,472	3,469	372	27,938
Louisiana and Texas	211,691	38,444	1,238	425	251,798
Montana and Idaho	947	--	--	--	947
New Hampshire, Maine, Vermont, Delaware	11,386	11,921	429	123	23,859
North and South Carolina	10,509	10,109	--	--	20,618
Utah, Nevada, Arizona	26	--	--	--	26
Total	1,059,418	455,921	68,768	15,320	1,599,427

[1] Includes lead that went directly from scrap to fabricated products and lead contained in leaded zinc oxide and other pigments.

Table 16.—Production and shipments of lead pigments[1] and oxides in the United States

Product	1973 Production (short tons)	1973 Shipments Short tons	1973 Shipments Value[2] Total	1973 Shipments Value[2] Average per ton	1974 Production (short tons)	1974 Shipments Short tons	1974 Shipments Value[2] Total	1974 Shipments Value[2] Average per ton
White lead, dry	7,103	9,544	$4,906,724	$514	5,905	5,905	$2,759,668	$467
Red lead	17,339	16,023	6,300,051	393	19,880	13,290	7,045,540	530
Litharge	175,167	179,144	61,729,436	345	153,562	161,445	79,390,214	492
Black oxide	342,283	--	--	--	410,716	--	--	--

[1] Excludes basic lead sulfate, figures withheld to avoid disclosing individual company confidential data.
[2] At plant, exclusive of container.

Table 17.—Lead content of lead and zinc pigments[1] and lead oxides produced by domestic manufacturers, by source

(Short tons)

Product	1973 Lead in pigments produced from— Ore Domestic	1973 Ore Foreign	1973 Pig lead	1973 Total lead in pigments	1974 Lead in pigments produced from— Ore Domestic	1974 Ore Foreign	1974 Pig lead	1974 Total lead in pigments
White lead	--	--	5,682	5,682	--	--	4,724	4,724
Red lead	--	--	15,718	15,718	--	--	18,021	18,021
Litharge	--	--	162,905	162,905	--	--	142,813	142,813
Black oxide	--	--	326,580	326,580	--	--	392,421	392,421
Leaded zinc oxide	W	W	--	W	W	W	--	W
Total	W	W	510,885	510,885	W	W	557,979	557,979

W Withheld to avoid disclosing individual company confidential data.
[1] Excluding lead in basic lead sulfate.

Table 18.—Distribution of white lead (dry and in oil) shipments,[1] by industry

(Short tons)

Industry	1970	1971	1972	1973	1974
Paints	4,460	4,396	6,768	3,198	--
Ceramics	26	34	31	18	--
Other	4,152	2,351	3,267	6,328	5,905
Total	8,638	6,781	10,066	9,544	5,905

[1] Excludes basic lead sulfate, figures withheld to avoid disclosing individual company confidential data.

Table 19.—Distribution of red lead shipments, by industry

(Short tons)

Industry	1970	1971	1972	1973	1974
Paints	7,848	8,717	4,909	6,509	5,344
Storage batteries	W	W	W	W	W
Other	11,596	12,272	14,864	9,514	7,946
Total	19,444	20,989	19,773	16,023	13,290

W Withheld to avoid disclosing individual company confidential data; included with "Other."

Table 20.—Distribution of litharge shipments, by industry
(Short tons)

Industry	1970	1971	1972	1973	1974
Ceramics	24,578	24,337	23,188	35,910	46,598
Insecticides	W	W	W	W	W
Oil refining	2,016	1,413	1,262	620	765
Paints	1,315	3,085	7,316	3,112	5,347
Rubber	1,663	2,081	2,162	5,078	6,490
Other	116,771	116,928	113,694	134,424	102,245
Total	146,343	147,844	147,622	179,144	161,445

W Withheld to avoid disclosing individual company confidential data; included with "Other."

Table 21.—U.S. imports for consumption of lead pigments and compounds

Kind	1973		1974	
	Quantity (short tons)	Value (thousands)	Quantity (short tons)	Value (thousands)
Whilte lead	401	$268	149	$181
Red lead	593	188	709	424
Litharge	14,318	4,840	8,647	4,392
Chrome yellow	4,492	2,972	4,360	4,237
Other lead pigments	357	139	99	70
Other lead compounds	354	195	420	697
Total	20,515	8,602	14,384	10,001

Table 22.—Stocks of lead at primary smelters and refineries in the United States, Dec. 31
(Short tons)

Stocks	1970	1971	1972	1973	1974
Refined pig lead	90,866	46,762	60,840	22,018	34,116
Lead in antimonial lead	6,988	5,318	3,626	4,062	3,138
Lead in base bullion	11,710	13,803	11,514	8,845	5,492
Lead in ore and matte	83,421	55,777	69,593	54,922	78,305
Total	192,985	121,660	145,573	89,847	121,051

Table 23.—Consumer stocks of lead in the United States Dec. 31, by type of material
(Short tons, lead content)

Year	Refined soft lead	Lead in antimonial lead	Lead in alloys	Lead in copper-base scrap	Total
1970	82,823	42,420	7,344	915	133,502
1971	81,934	35,700	6,979	964	125,577
1972	74,161	36,157	6,977	1,249	118,544
1973	84,274	32,226	6,954	667	124,121
1974	106,245	49,504	9,628	1,212	166,589

Table 24.—Average monthly and yearly quoted prices of lead[1]
(Cents per pound)

Month	1973		1974	
	U.S. producer	London Metal Exchange	U.S. producer	London Metal Exchange
January	14.82	14.42	18.98	25.62
February	15.39	15.41	19.00	29.40
March	16.00	16.87	19.53	32.13
April	16.02	17.54	21.49	31.83
May	16.48	17.96	21.50	30.29
June	16.50	19.27	22.90	25.83
July	16.50	21.28	24.50	24.83
August	16.50	19.85	24.50	24.90
September	16.50	20.14	24.50	24.41
October	16.50	21.36	24.50	24.33
November	16.50	22.13	24.50	24.17
December	17.72	26.84	24.50	24.20
Average	16.29	19.47	22.53	26.83

[1] Metals Week. Quotations for United States on a nationwide, delivered basis.

Table 25.—U.S. exports of lead, by country[1]

Destination	1973		1974	
	Quantity (short tons)	Value (thousands)	Quantity (short tons)	Value (thousands)
Unwrought lead and lead alloys:				
Belgium-Luxembourg	1,632	$702	13,895	$4,293
Brazil	8,681	2,744	5,674	2,942
Canada	1,177	442	4,880	2,333
Chile	--	--	81	186
Dominican Republic	24	15	5	11
Ecuador	20	7	261	228
France	11	9	259	176
Germany, West	554	214	450	215
Greece	1,102	60	1	(1)
Honduras	58	28	22	20
Hong Kong	119	35	46	28
Italy	5,791	2,157	6,251	3,101
Jamaica	8	5	57	68
Japan	22,169	9,222	5,278	2,789
Korea, Republic of	1,801	616	772	375
Mexico	878	356	1,036	417
Netherlands	5,849	2,064	8,364	4,592
Philippines	57	46	385	242
Portugal	208	100	--	--
Singapore	71	26	88	40
Spain	35	14	1,860	932
Switzerland	220	71	--	--
Taiwan	170	61	99	50
Thailand	--	--	242	147
Trinidad and Tobago	--	--	100	92
Turkey	788	310	661	449
United Kingdom	270	109	1,918	1,200
Venezuela	107	40	124	17
Vietnam, South	--	--	151	71
Other	61	49	628	334
Total	51,861	19,502	53,588	25,348
Wrought lead and lead alloys:				
Australia	27	64	77	154
Belgium-Luxembourg	1,213	458	367	437
Brazil	66	31	18	13
Canada	459	624	538	461
Colombia	13	50	31	30
Denmark	278	24	11	12
Dominican Republic	75	167	33	47
Ecuador	36	20	69	96
France	30	44	237	177
Germany, West	39	43	98	246
Hong Kong	114	49	1	3
Israel	1	4	359	218
Italy	4,469	1,531	57	52
Jamaica	17	11	13	49
Japan	869	502	305	717
Korea, Republic of	539	353	108	45
Mexico	588	595	688	651
Netherlands	5,279	2,203	3,223	1,537
Panama	73	84	77	116
Saudi Arabia	6	8	46	64
Sweden	37	31	42	48
Taiwan	52	38	100	159
United Kingdom	117	173	546	446
Venezuela	42	175	212	236
Vietnam, South	41	24	863	596
Other	235	289	275	727
Total	14,715	7,595	8,394	7,337

See footnotes at end of table.

Table 25.—U.S. exports of lead, by country[1]—Continued

Destination	1973		1974	
	Quantity (short tons)	Value (thousands)	Quantity (short tons)	Value (thousands)
Scrap:				
Belgium-Luxembourg	55	$5	1,123	$417
Brazil	5,327	1,149	5,247	1,263
Canada	23,186	3,033	22,760	4,462
Denmark	422	120	669	294
Germany, West	3,189	725	4,799	1,414
Hong Kong	40	14	136	62
Italy	1,575	511	5,197	2,729
Japan	[r] 9,504	[r] 3,005	991	370
Korea, Republic of	3,381	828	3,204	838
Malaysia	--	--	424	91
Mexico	37	16	1,399	232
Netherlands	3,550	847	2,214	588
Pacific Islands, Trust Territories of the	45	20	--	--
Pakistan	55	49	--	--
South Africa, Republic of	293	48	1,662	362
Spain	1,036	260	150	72
Sweden	448	79	--	--
Taiwan	4,045	682	2,630	687
Turkey	790	138	811	274
United Kingdom	450	170	1,182	639
Venezuela	2,420	522	3,879	1,530
Yugoslavia	--	--	648	358
Other	3	1	241	131
Total	[r] 59,851	[r] 12,222	59,366	16,813
Grand total	[r] 126,427	[r] 39,319	121,348	49,498

[r] Revised.

[1] In addition foreign lead was reexported as follows: Unwrought lead and lead alloys 1973, 3,410 tons ($1,801,316), 1974, 2,081 tons (1,413,551); scrap 1973, 103 tons ($13,451), 1974, 84 tons ($28,059); wrought lead and lead alloys 1973, 3 tons ($12,943), 1974, 1 ton ($780).

Table 26.—U.S. exports of lead, by class

Year	Blocks, pigs, anodes, etc.				Wrought lead and lead alloys				Scrap	
	Unwrought		Unwrought alloys		Sheets, plates, rods and other forms		Foil, powder and flakes			
	Quantity (short tons)	Value (thousands)	Quantity (short tons)	Value (thousands)	Quantity (short tons)	Value (thousands)	Quantity (short tons)	Value (thousands)	Quantity (short tons)	Value (thousands)
1972	5,134	$1,741	1,471	$719	1,375	$1,312	396	$728	35,233	$4,264
1973	46,778	17,538	5,083	1,964	14,160	7,010	555	585	[r] 59,851	[r] 12,222
1974	46,030	20,512	7,558	4,836	7,933	6,696	461	641	59,366	16,813

[r] Revised.

Table 27.—U.S. imports[1] of lead, by country

Country	1972		1973		1974	
	Quantity (short tons)	Value (thousands)	Quantity (short tons)	Value (thousands)	Quantity (short tons)	Value (thousands)
Ore, flue dust, and residues, n.s.p.f. (lead content):						
Australia	20,722	$4,350	21,728	$5,257	19,341	$6,446
Canada	[r] 30,195	[r] 6,338	[r] 18,378	[r] 3,773	16,035	4,880
Colombia	216	48	223	54	35	15
Honduras	17,790	2,543	20,254	4,229	18,520	7,645
Ireland	51	10	129	10	34	5
Japan	--	--	[r] 21,583	[r] 3,885	--	--
Mexico	[r] 1,097	[r] 188	[r] 1,667	[r] 506	10,631	4,186
Nicaragua	3,329	537	1,934	489	3,493	1,518
Peru	27,820	6,021	24,033	5,779	26,201	8,536
Other	[r] 62	[r] 14	18	1	9	9
Total	[r] 101,282	[r] 20,049	[r] 109,947	[r] 23,983	94,299	33,240
Base bullion (lead content):						
Canada	895	238	4	1	831	331
Pigs and bars (lead content):						
Australia	35,638	8,677	45,550	12,274	3,308	1,537
Belgium-Luxembourg	2,903	822	27	60	1,338	1,106
Burma	186	46	--	--	--	--
Canada	82,816	22,234	[r] 61,927	[r] 18,950	40,100	18,578
Denmark	843	331	242	125	198	226
France	123	45	(2)	6	50	54
Germany:						
East	1,102	265	--	--	81	169
West	1,445	513	115	236	544	2,845
Japan	--	--	--	--	2,608	1,850
Mexico	35,513	8,069	20,388	5,690	28,504	13,795
Netherlands	2,292	693	275	343	354	437
Peru	49,260	13,320	42,772	12,948	39,986	14,850
Singapore	--	--	--	--	59	19
South Africa, Republic of	8,804	2,698	5,644	1,718	--	--
Sweden	27	22	43	21	3	10
Switzerland	7,994	2,067	--	--	--	--
Thailand	--	--	--	--	144	655
United Kingdom	11,777	3,160	1,121	561	1,054	1,523
Yugoslavia	1,651	460	--	--	--	--
Other	16	23	13	7	35	37
Total	242,390	63,445	[r] 178,117	[r] 52,939	118,366	57,691
Reclaimed scrap, etc. (lead content):						
Australia	2,472	559	[r] 2,199	[r] 420	105	42
Bahamas	32	4	28	3	--	--
Canada	[r] 500	[r] 133	183	28	594	336
Canal Zone	--	--	--	--	7	16
Dominican Republic	42	11	18	3	11	5
Mexico	[r] 366	[r] 53	[r] 865	138	271	85
Netherlands	--	--	61	23	--	--
Panama	--	--	13	10	11	3
United Kingdom	51	19	--	--	204	361
Other	--	--	2	(2)	10	8
Total	[r] 3,463	[r] 779	[r] 3,369	[r] 625	1,213	856
Grand total	[r] 348,030	[r] 84,511	[r] 291,437	[r] 77,548	214,709	92,118

[r] Revised.

[1] Data are "general imports" that is, they include lead imported for immediate consumption plus material entering the country under bond.

[2] Less than ½ unit.

Table 28.—U.S. imports for consumption [1] of lead, by country

Country	1972		1973		1974	
	Quantity (short tons)	Value (thousands)	Quantity (short tons)	Value (thousands)	Quantity (short tons)	Value (thousands)
Ore, flue dust, and residues, n.s.p.f. (lead content):						
Argentina	27	$7	50	$10	--	--
Australia	12,887	3,150	25,897	5,208	15,156	$3,753
Bolivia	--	--	583	108	9	9
Brazil	--	--	372	67	--	--
Canada	r 14,788	r 3,258	r 12,269	r 2,336	11,998	2,712
Colombia	234	41	--	--	--	--
Honduras	8,300	1,213	21,780	2,785	15,536	3,536
Ireland	--	--	129	10	--	--
Mexico	r 3,426	r 269	r 251	r 54	6	1
Morocco	41	9	--			
Nicaragua	--	--	424	87	2,518	729
Peru	11,910	2,596	32,535	6,715	17,468	4,440
Other	r 14	r 4	9	2	--	--
Total	r 51,627	r 10,547	r 94,299	r 17,382	62,691	15,180
Base bullion (lead content):						
Canada	895	238	4	1	831	331
Pigs and bars (lead content):						
Australia	38,637	9,272	45,550	12,274	3,308	1,537
Belgium-Luxembourg	2,903	822	27	60	1,338	1,106
Burma	186	46	--	--	--	--
Canada	83,008	22,285	r 61,927	r 18,950	40,100	18,578
Denmark	843	331	242	125	198	226
France	123	45	(2)	6	50	54
Germany:						
East	1,102	265	--	--	81	169
West	1,445	513	114	234	545	2,847
Japan	--	--	--	--	2,608	1,850
Mexico	35,513	8,069	20,388	5,690	28,504	13,795
Netherlands	2,292	693	275	343	354	437
Peru	49,260	13,320	42,772	12,948	39,986	14,850
Singapore	--	--	--	--	59	19
South Africa, Republic of	8,804	2,698	5,644	1,718	--	--
Sweden	27	22	43	21	3	10
Switzerland	7,994	2,067	--	--	--	--
Thailand	--	--	--	--	144	655
United Kingdom	11,794	3,165	1,121	561	1,054	1,523
Yugoslavia	1,651	460	--	--	--	--
Other	16	23	13	7	35	37
Total	245,598	64,096	r 178,116	r 52,937	118,367	57,693
Reclaimed scrap, etc. (lead content):						
Australia	r 3,173	r 758	1,699	352	--	--
Bahamas	31	4	28	3	--	--
Canada	r 361	r 106	r 246	r 40	755	368
Canal Zone	--	--	--	--	7	16
Dominican Republic	r 43	11	18	3	11	5
Mexico	r 288	r 43	r 1,040	r 157	238	73
Netherlands	--	--	61	23	--	--
Panama	--	--	13	10	11	3
United Kingdom	55	20	--	--	204	361
Other	--	--	2	(2)	10	8
Total	r 3,951	r 942	r 3,116	r 588	1,236	834
Sheets, pipe, and shot:						
Belgium-Luxembourg	25	10	18	r 9	--	--
Canada	76	37	r 7	r 5	110	71
Japan	--	--	1	(2)	11	24
Mexico	998	286	734	285	71	39
Netherlands	44	14	12	4	(2)	1
South Africa, Republic of	15	7	--	--	--	--
United Kingdom	37	16	--	--	4	3
Yugoslavia	30	8	--	--	--	--
Other	--	--	--	--	(2)	(2)
Total	r 1,225	r 378	r 772	r 303	196	138
Grand total	r 303,296	r 76,201	r 276,307	r 71,211	183,321	74,176

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r Revised.

[1] Excludes imports for refining, classified as "imports for consumption" by the Bureau of Census.

[2] Less than ½ unit.

Table 29.—U.S. imports for consumption of lead, by class[1]

(Thousand short tons and thousand dollars)

Year	Ore (lead content)		Base bullion (lead content)		Pigs and bars (lead content)		Sheets, plates, strip, and other forms	
	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value
1972	52	r 10,547	1	238	246	64,096	(2)	r 94
1973	94	r 17,382	(2)	1	r 178	r 52,937	(2)	18
1974	63	15,180	1	331	118	57,693	(2)	78

Year	Waste and scrap (lead content)		Dross, skimmings, residues, n.s.p.f. (lead content)		Powder and flakes		Total value
	Quantity	Value	Quantity	Value	Quantity	Value	
1972	r 1	r 177	3	765	1	284	r 76,201
1973	r 1	r 170	2	418	1	285	r 71,211
1974	1	406	(2)	428	(2)	60	74,176

r Revised.

[1] Excludes imports for refining and export, classified as "imports for consumption" by the Bureau of the Census.

[2] Less than ½ unit.

Table 30.—U.S. imports for consumption of miscellaneous products containing lead

Year	Babbitt metal, solder, white metal, and other combinations containing lead		
	Gross weight (short tons)	Lead content (short tons)	Value (thousands)
1972	1,197	464	$3,354
1973	1,440	533	4,780
1974	1,643	724	8,780

Table 31.—Lead: World mine production, by country

(Short tons)

Country[1]	1972	1973	1974[p]
North America:			
Canada	407,887	427,441	365,000
Guatemala	152	112	• 110
Honduras	22,844	21,160	19,316
Mexico[2]	177,866	197,640	240,327
Nicaragua	4,719	3,000	3,746
United States[3]	618,915	603,024	663,870
South America:			
Argentina	[r] 42,289	38,713	39,700
Bolivia	22,602	23,143	19,234
Brazil	[r] 32,937	29,531	27,672
Chile	509	282	463
Colombia	324	169	139
Peru[4]	[r] 203,245	218,920	224,900
Europe:			
Austria[3]	7,350	6,767	6,377
Bulgaria	112,400	115,700	119,000
Czechoslovakia •	[r] 6,170	6,600	6,600
Finland	4,243	2,346	1,629
France	[r] 27,882	26,160	22,916
Germany, East •	7,700	7,700	4,400
Germany, West	[r] 42,582	38,460	33,636
Greece	17,607	19,596	• 22,000
Greenland	--	6,280	26,570
Hungary •	2,610	[r] 2,760	1,760
Ireland	[r] 65,720	61,950	41,560
Italy	[r] 37,150	28,550	24,525
Norway	[r] 3,780	4,002	3,859
Poland	75,000	77,200	79,400
Portugal	1,275	1,299	1,320
Romania •	[r] 41,900	[r] 45,200	45,200
Spain	76,548	70,998	66,122
Sweden	83,600	83,530	80,140
U.S.S.R. •	510,000	520,000	523,600
United Kingdom	440	220	--
Yugoslavia	132,468	131,519	132,060
Africa:			
Algeria	[r] 5,407	4,273	5,290
Congo (Brazzaville)	521	880	1,320
Morocco	95,460	119,054	95,098
Nigeria •	[r] 350	[r] 380	410
South Africa, Republic of	151	1,789	3,237
South-West Africa, Territory of[5]	66,128	68,006	[6] 63,241
Tunisia	[r] 20,170	17,635	10,870
Zambia (refined)	[r] 29,349	27,574	27,120
Asia:			
Burma •	[r] 11,000	11,570	10,800
China, People's Republic of •	110,000	110,000	110,000
India	2,798	4,728	10,083
Indonesia	• 220	• 220	--
Iran[7]	[r] 48,006	66,100	66,100
Japan[8]	[r] 69,940	58,300	48,767
Korea, North •	[r] 88,000	[r] 99,000	111,000
Korea, Republic of	16,224	14,188	11,573
Pakistan	(9)	(9)	--
Thailand	2,005	4,083	1,701
Turkey	6,862	3,279	5,073
Oceania:			
Australia	[r] 436,516	446,200	415,853
New Zealand[10]	1,273	362	--
Total	[r] 3,801,094	3,877,593	3,844,687

• Estimate. [p] Preliminary. [r] Revised.

[1] In addition to the countries listed, Uganda and Egypt may produce lead, but available information is inadequate to make reliable estimates of output levels.

[2] Recoverable metal; lead content of concentrates for export plus lead content of domestic products (refined lead, antimonial lead, mixed bars, and other unspecified items).

[3] Recoverable metal.

[4] Recoverable metal; lead content of concentrates for exports plus lead content of domestic smelter products (refined lead, antimonial lead, and bismuth-lead bars).

[5] Data compiled from operating company reports of Tsumeb Corp. Ltd., South West Africa Co. Ltd., and South African Iron and Steel Industrial Corp. Ltd. (ISCOR) for Imcor Zinc (Pty.) Ltd.'s Rosh Pinah mine. Data from Tsumeb Corp. Ltd. are for calendar years; data from other companies are for fiscal years ending June 30 of the year stated.

[6] Figure comprises reported production of Tsumeb Corp. Ltd. and South West Africa Co. Ltd. plus an estimate for Rosh Pinah mine.

[7] Year beginning March 21 of that stated.

[8] Content of concentrates.

[9] Less than ½ unit.

[10] Contained in lead-copper concentrate.

Table 32.—Lead: World smelter production by country[1]

(Short tons)

Country	1972	1973	1974 p
North America:			
Canada (refined)	205,978	206,012	138,000
Guatemala[2]	24	72	250
Mexico (refined)	171,762	190,621	220,660
United States (refined)[3]	688,584	687,739	684,440
South America:			
Argentina	r 43,650	52,900	60,190
Bolivia (refined, including solder)	r • 20	r • 20	23
Brazil	r 27,565	38,357	45,951
Peru (refined)	r 94,809	91,788	88,850
Europe:			
Austria[4]	10,777	10,927	9,705
Belgium[2]	r 107,370	113,500	109,790
Bulgaria[2]	r 112,400	110,000	119,000
Czechoslovakia •[2]	20,100	22,000	19,800
France	r 186,943	183,633	175,992
Germany, East •	22,000	22,000	22,000
Germany, West	r 112,660	94,580	128,310
Greece (refined)[4]	22,490	22,820	16,090
Hungary •[2]	r 4,400	r 8,800	14,880
Italy	r 55,268	38,721	47,912
Netherlands[2]	24,230	27,840	29,112
Poland (refined)[2]	71,980	71,700	72,800
Portugal (refined)	r 1,320	1,100	1,210
Romania •	r 39,700	43,000	43,000
Spain	r 91,437	96,256	87,293
Sweden (refined)	r 52,395	51,408	45,080
U.S.S.R. (primary) •	510,000	520,000	525,000
United Kingdom[5]	27,615	33,407	32,386
Yugoslavia (refined)[2]	r 112,616	124,155	• 140,000
Africa:			
South-West Africa, Territory of (refined)	70,505	70,098	70,925
Tunisia	[6] 27,638	28,619	29,102
Zambia (refined)	r 29,349	27,574	27,117
Asia:			
Burma	r 10,567	11,162	10,246
China, People's Republic of •	110,000	110,000	110,000
India	3,020	3,147	4,189
Iran •[7]	210	220	230
Japan (refined)	r 211,750	208,797	197,500
Korea, North •	83,000	r 90,000	110,000
Korea, Republic of	4,196	4,823	4,881
Philippines	--	--	1,436
Turkey	2,650	3,530	2,430
Oceania: Australia (refined and bullion)	r 352,431	375,092	374,764
Total	r 3,723,409	3,796,413	3,820,544

• Estimate. p Preliminary. r Revised.

[1] Primary except as noted, or where source does not differentiate.

[2] Includes recovery from secondary materials.

[3] Refined from domestic and foreign ores; excludes lead refined from imported base bullion.

[4] Includes primary lead content of antimonial lead.

[5] Lead bullion from imported ores and concentrates.

[6] Pig lead only (excludes lead content of antimonial lead).

[7] Year beginning March 21 of year stated.

Lime

By Avery H. Reed [1]

Lime output in 1974, including that for Puerto Rico, increased 2% to 21.6 million tons, a new annual record. Total value was a record $476.6 million, 29% above 1973.

Colorado Lien Co. planned to construct a 350-ton-per-day lime plant at Buena Vista, Colo. Dravo Lime Co. started construction of a lime plant at Maysville, Ky.; the $46 million, 3,000-ton-per-day plant will produce lime for use in removing sulfur from stack gases. Inland Steel Co. completed the first year of operation at the Indiana Harbor Works.

Table 1.—Salient lime statistics in the United States [1]
(Thousand short tons and thousand dollars)

	1970	1971	1972	1973	1974
Number of plants	194	187	185	175	172
Sold or used by producers:					
Quicklime	15,248	15,138	16,611	17,230	17,795
Hydrated lime	3,126	3,446	2,604	2,610	2,533
Dead-burned dolomite	1,373	1,007	1,075	1,250	1,278
Total	19,747	19,591	20,290	21,090	21,606
Value [2]	$286,155	$308,100	$339,304	$365,849	$473,685
Average value per ton	$14.49	$15.73	$16.72	$17.35	$21.92
Lime sold	12,718	12,337	13,353	14,394	14,640
Lime used	7,029	7,254	6,937	6,696	6,966
Exports [3]	54	66	38	37	32
Imports for consumption [3]	202	242	248	334	416

[1] Excludes regenerated lime. Excludes Puerto Rico.
[2] Selling value, f.o.b. plant, excluding cost of containers.
[3] Bureau of the Census.

DOMESTIC PRODUCTION

Lime producers in the United States and Puerto Rico sold or used a record 21.6 million tons, compared with 21.1 million tons in 1973. Sales of lime increased 2% to 14.7 million tons for a new annual record. Captive lime used by producers increased 4% to 7.0 million tons but was 4% below the 1971 record.

Output of quicklime increased 3% to 19.1 million tons. Production of hydrate decreased 3% to 2.6 million tons. Output of dead-burned dolomite increased 2% to 1.3 million tons but was 47% below the 1956 record. The number of plants decreased from 176 to 173, and the average output per plant increased from 120,000 to 125,100 tons per year.

Eight States, Ohio, Pennsylvania, Missouri, Texas, Michigan, Indiana, Alabama, and Illinois, each producing more than 1 million tons, accounted for 68% of the total output.

Leading producing companies were Marblehead Lime Co. with four plants in Illinois, one in Indiana, one in Michigan, and one in Pennsylvania; Mississippi Lime Co. in Missouri; Bethlehem Steel Corp. with one plant in New York and two in

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[1] Supervisory physical scientist, Division of Nonmetallic Minerals.

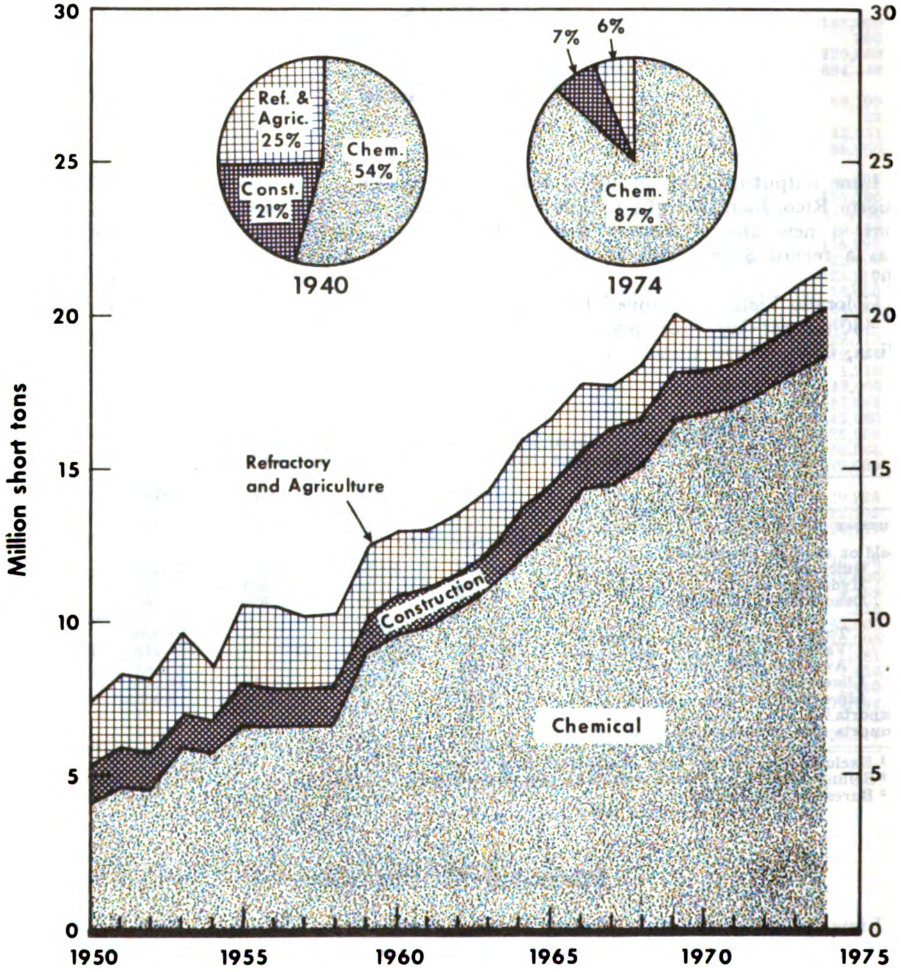

Figure 1.—Trends in major uses of lime.

Pennsylvania; Allied Chemical Corp. with a plant in Louisiana and a plant in New York; Martin-Marietta Chemicals with a plant in Alabama and a plant in Ohio; United States Gypsum Co. with a plant in Louisiana, a plant in Ohio, and a plant in Texas; United States Steel Corp. in Ohio; The Dow Chemical Co. with a plant in Michigan and a plant in Texas; Diamond Shamrock Corp. in Ohio; and Pfizer Inc. with plants in California, Connecticut, Massachusetts, and Ohio. These 10 companies, operating 26 plants, accounted for 41% of the total lime production.

The nine largest lime plants, each producing more than 400,000 tons per year, accounted for 27% of the total lime production. Forty-two plants produced more than 200,000 tons per year, and accounted for 69% of the total output.

Leading individual plants were Mississippi Lime's Ste. Genevieve plant, Marblehead's Buffington plant, Allied Chemical's Syracuse plant, United States Steel's Lorain plant, and Diamond Shamrock's Painesville plant.

Table 2.—Lime sold or used by producers in the United States, by State and kind[1]

(Thousand short tons and thousand dollars)

State	1973				1974			
	Hydrated	Quick-lime	Total[2]	Value	Hydrated	Quick-lime	Total[2]	Value
Alabama	140	741	881	14,050	128	925	1,054	22,346
Arizona	W	W	365	7,019	W	W	422	9,071
Arkansas	W	W	177	2,742	W	W	187	3,189
California	57	575	632	13,602	62	537	600	14,877
Colorado	7	172	178	3,371	W	W	198	3,815
Connecticut	W	W	W	W	17	16	33	1,148
Florida	W	W	187	4,026	W	W	185	5,315
Hawaii	W	W	6	238	W	W	6	221
Kansas	--	10	10	199	--	28	28	535
Louisiana	W	W	897	16,801	W	W	796	17,665
Maryland	W	W	W	W	6	17	23	527
Massachusetts	W	W	W	W	25	145	170	4,972
Michigan	--	1,545	1,545	26,055	--	1,528	1,528	30,036
Mississippi	W	W	W	W	--	70	70	1,393
Missouri	254	1,373	1,626	23,534	W	W	1,901	36,369
Montana	--	210	210	3,028	--	226	226	3,364
Nebraska	--	31	31	651	--	36	36	591
New Mexico	--	44	44	793	--	58	58	1,679
Ohio	227	4,163	4,389	77,028	196	3,975	4,171	93,695
Oregon	W	W	106	2,552	W	W	98	2,818
Pennsylvania	399	1,862	2,260	40,949	405	1,675	2,080	50,147
Puerto Rico	42	--	42	2,215	39	--	39	2,923
South Dakota	39	24	63	1,206	46	47	94	2,059
Tennessee	W	W	W	W	W	W	136	3,449
Texas	655	1,022	1,677	26,887	713	1,122	1,835	39,644
Utah	W	W	185	3,804	W	W	176	4,911
Virginia	68	715	782	12,205	63	832	895	18,929
West Virginia	W	W	W	W	W	W	128	2,315
Wisconsin	111	199	310	6,004	121	190	311	6,764
Wyoming	--	30	30	548	--	29	29	464
Other States[3]	653	5,764	4,499	78,556	751	7,617	4,132	91,377
Total	2,652	18,480	21,132	368,063	2,572	19,073	21,645	476,608

W Withheld to avoid disclosing individual company confidential data; included in "Other States."

[1] Excludes regenerated lime. Includes Puerto Rico.

[2] Data may not add to totals shown because of independent rounding.

[3] Includes Idaho, Illinois, Indiana, Iowa, Kentucky, Minnesota, Nevada, New Jersey (1973), New York, North Dakota, Oklahoma, Washington, and States indicated by symbol W.

Table 3.—Lime sold or used by producers in the United States, by State and market[1]

(Thousand short tons)

State	1973				1974			
	Plants	Sold	Captive	Total[2]	Plants	Sold	Captive	Total[2]
Alabama	5	W	W	881	5	W	W	1,054
Arizona	8	237	128	365	8	213	209	422
Arkansas	3	W	W	177	3	W	W	187
California	15	243	388	632	15	236	364	600
Colorado	11	7	172	179	11	8	190	198
Connecticut	1	W	--	W	1	33	--	33
Florida	3	W	W	187	3	W	W	185
Hawaii	2	W	W	6	2	W	W	6
Kansas	1	--	10	10	1	--	28	28
Louisiana	4	W	W	897	4	W	W	796
Maryland	1	W	--	W	1	23	--	23
Massachusetts	2	W	W	W	2	W	W	170
Michigan	9	W	W	1,545	9	W	W	1,528
Mississippi	1	--	W	W	1	--	70	70
Missouri	4	W	W	1,626	3	W	W	1,901
Montana	3	--	210	210	3	--	226	226
Nebraska	5	4	27	31	4	--	36	36
New Mexico	1	--	44	44	2	W	W	58
Ohio	19	2,914	1,476	4,389	17	2,758	1,414	4,171
Oregon	3	W	W	106	3	W	W	98
Pennsylvania	9	W	W	2,260	10	W	W	2,080
Puerto Rico	1	42	--	42	1	39	--	39
South Dakota	1	68	--	68	1	94	--	94
Tennessee	2	W	--	W	3	W	W	186
Texas	14	1,090	587	1,677	13	1,164	671	1,835
Utah	5	W	W	185	5	W	W	176
Virginia	7	W	W	782	6	W	W	895
West Virginia	2	W	W	W	2	W	W	128
Wisconsin	5	310	--	310	5	311	--	311
Wyoming	3	--	30	30	3	--	29	29
Other States[3]	26	9,526	3,624	4,499	26	9,800	3,729	4,132
Total	176	14,436	6,696	21,132	173	14,679	6,966	21,645

W Withheld to avoid disclosing individual company confidential data; included in "Other States."

[1] Excludes regenerated lime. Includes Puerto Rico.

[2] Data may not add to totals shown because of independent rounding.

[3] Includes Idaho (4 plants), Illinois (5), Indiana (2), Iowa (1), Kentucky (1), Minnesota (3), Nevada (3), New Jersey (1—1973), New York (2), North Dakota (1), Oklahoma (1), Washington (3), and States indicated by symbol W.

Table 4.—Lime sold or used by producers in the United States, by size of plant[1]

Size of plant	1973			1974		
	Plants	Quantity (thousand short tons)	Percent of total	Plants	Quantity (thousand short tons)	Percent of total
Less than 10,000 tons	29	155	1	28	173	1
10,000 to 25,000 tons	31	414	2	35	635	3
25,000 to 50,000 tons	26	917	4	18	626	3
50,000 to 100,000 tons	27	1,965	9	28	2,018	9
100,000 to 200,000 tons	24	3,572	17	22	3,161	15
200,000 to 400,000 tons	27	7,370	35	33	9,193	42
More than 400,000 tons	12	6,739	32	9	5,839	27
Total	176	21,132	100	173	21,645	100

[1] Excludes regenerated lime. Includes Puerto Rico.

CONSUMPTION AND USES

Lime was consumed in every State. Leading consuming States were Ohio, Pennsylvania, Indiana, Texas, Michigan, and Illinois, each of which consumed more than 1 million tons. These six States accounted for 58% of the total lime consumed.

Leading quicklime-consuming States were Ohio, Pennsylvania, Indiana, Michigan, Texas, and Illinois. These six States consumed more than 1 million tons each and accounted for 59% of the total quicklime consumed.

Leading hydrate-consuming States were Texas, Pennsylvania, Ohio, Illinois, and Louisiana, each of which consumed more than 100,000 tons. These five States accounted for 52% of the total hydrate consumed.

Lime sold by producers was used for chemicals, 81%; construction, 10%; refractories, 8%; and agriculture, 1%. Captive lime used by producers was 32% of the total, compared with 32% in 1973 and 34% in 1972. Captive lime was used mainly for alkalies, 37%; BOF steel furnaces, 24%; and sugar refining, 10%.

Leading individual uses were BOF steel furnaces, alkalies, water purification, refractories, and paper and pulp, which together accounted for 63% of the total consumption.

Lime for chemical and industrial use increased 4% to a record 18.8 million tons. Lime for refractory dolomite increased 2%. Lime for construction decreased 9%, and lime used in agriculture declined 22%.

Leading States for finishing lime were Ohio (41%), Nevada (23%), and Missouri (18%); those for mason's lime were Pennsylvania (21%), Wisconsin, and Ohio (13%). Lime for soil stabilization was used in Texas, which consumed 68% of the total, and other States.

Leading States for lime used in agriculture were Pennsylvania (34%), Maryland (21%), and Virginia (11%). Dead-burned dolomite was used in Ohio (58%), Pennsylvania (17%), Illinois (10%), and other States.

Of the main chemical and industrial uses, lime for BOF steel furnaces was consumed principally in Ohio (27%), Indiana (14%), Pennsylvania (14%), and Illinois (10%). Lime for alkalies was used mainly in Michigan (24%), New York (23%), and Louisiana (19%). Lime for water purification was used in Missouri (31%), Pennsylvania (16%), Texas (8%), Alabama (7%), and the remainder in other States. Lime used for paper and pulp, excluding regenerated lime, was consumed primarily in Alabama (36%), Texas (14%), and Virginia (10%). Lime for electric steel mills was used mainly in Missouri (16%), Texas (14%), Pennsylvania (14%), and Ohio (12%).

PRICES

The average value of lime sold or used by producers in 1974 was $22.02 per ton, an increase of 26% over the 1973 price of $17.42.

Values ranged from $21.51 for chemical lime to $25.11 for refractory dolomite, $25.33 for construction lime, and $28.46 for lime used in agriculture.

Values for quicklime sold ranged from $20.64 for chemical lime to $25.03 for dead-burned dolomite, $28.27 for lime used in agriculture, and $30.32 for construction lime, and averaged $21.22, an increase of 31% over the 1973 value.

Values for hydrated lime sold ranged from $22.15 for construction lime to $26.21 for chemical lime and $28.58 for lime used in agriculture, and averaged $25.66, an increase of 25% over the 1973 value.

Table 5.—Lime sold or used by producers in the United States, by use [1]

(Thousand short tons and thousand dollars)

Use	1973				1974			
	Sold	Used	Total [2]	Value	Sold	Used	Total [2]	Value
Agriculture	140	--	140	2,796	109	--	109	3,104
Construction:								
Soil stabilization	874	4	878	17,705	W	W	797	20,202
Mason's lime	444	62	506	10,216	W	W	376	9,520
Finishing lime	219	--	219	4,422	225	--	225	5,700
Other construction uses	9	--	9	182	W	W	64	1,620
Total [2]	1,546	66	1,611	32,525	1,405	58	1,463	37,042
Chemical and industrial:								
Steel, BOF	5,612	1,454	7,065	117,138	5,669	1,658	7,327	158,000
Alkalies	5	2,679	2,683	48,811	W	W	2,589	55,700
Water purification	1,458	10	1,469	23,743	W	W	1,361	29,300
Paper and pulp	832	75	907	14,809	W	W	1,064	22,900
Steel, electric	575	65	604	10,474	724	81	805	17,300
Sugar refining	79	696	775	13,937	67	707	774	16,700
Copper ore concentration	275	355	630	10,901	280	431	711	15,300
Steel, open-hearth	593	82	675	11,074	W	W	663	14,300
Sewage treatment	440	12	452	7,239	535	31	567	12,200
Aluminum and bauxite	W	W	390	6,639	W	W	384	8,260
Glass	368	--	368	5,947	308	--	308	6,630
Calcium carbide	W	W	216	3,710	W	W	263	5,660
Petrochemicals	162	W	162	2,618	97	--	97	2,090
Acid mine water	71	3	73	1,202	W	W	84	1,810
Precipitated calcium carbonate	W	W	70	1,198	W	--	W	W
Food products	33	--	33	533	W	W	72	1,550
Petroleum refining	43	--	43	695	61	--	61	1,310
Metallurgy, other	W	W	69	1,172	W	W	50	1,080
Chrome	2	40	42	760	--	W	W	W
Plastics	37	--	37	598	W	--	W	W
Tanning	26	--	26	420	24	--	24	516
Magnesium metal	37	15	52	871	W	W	23	494
Oil well drilling	13	--	13	210	16	--	16	344
Silica brick	2	--	2	32	14	--	14	301
Ore concentration, other	24	--	24	388	8	--	8	172
Fertilizer	7	--	7	113	8	--	8	172
Insecticides	24	--	24	388	7	--	7	151
Rubber	3	--	3	48	5	--	5	108
Sulfur removal	1	--	1	16	4	--	4	86
Sand-lime brick	W		W	W	4	--	4	86
Wire drawing	W	W	2	34	W	W	3	65
Paint	3	--	3	48	3	--	3	65
Other uses [3]	860	1,060	1,175	20,977	4,136	3,917	1,497	31,734
Total [2]	11,585	6,546	18,131	306,748	11,970	6,825	18,796	404,384
Refractory dolomite	1,166	84	1,250	25,999	1,195	82	1,277	32,078
Grand total [2]	14,436	6,696	21,132	368,063	14,679	6,966	21,645	476,608

W Withheld to avoid disclosing individual company confidential data; included with "Other uses."

[1] Excludes regenerated lime. Includes Puerto Rico.

[2] Data may not add to totals shown because of independent rounding.

[3] Includes magnesia from seawater, magnesite, coke, lithium, explosives, adhesives, and uses indicated by symbol W.

Table 6.—Destination of shipments of lime sold or used by producers in the United States in 1974, by State[1]

(Short tons)

State	Quicklime	Hydrated lime	Total[2]
Alabama	389,800	67,560	457,400
Arizona	W	W	410,500
Arkansas	158,500	25,120	183,600
California	730,100	69,010	799,100
Colorado	225,400	15,680	241,100
Connecticut	52,820	14,050	66,860
Delaware	18,250	18,180	36,430
District of Columbia	W	W	1,776
Florida	333,700	48,800	382,500
Georgia	146,200	24,560	170,700
Hawaii	1,458	4,771	6,229
Idaho	89,470	11,200	100,700
Illinois	1,040,000	125,200	1,165,000
Indiana	1,788,000	81,140	1,869,000
Iowa	77,300	24,890	102,200
Kansas	77,780	16,510	94,290
Kentucky	408,600	17,420	426,000
Louisiana	705,600	103,200	808,800
Maine	19,720	2,258	21,980
Maryland	460,100	21,530	481,600
Massachusetts	41,900	20,190	62,090
Michigan	1,742,000	45,570	1,787,000
Minnesota	122,000	17,760	139,800
Mississippi	134,900	12,280	147,100
Missouri	190,700	40,870	231,500
Montana	226,900	1,419	228,300
Nebraska	53,280	13,740	67,010
Nevada	43,880	8,368	52,240
New Hampshire	W	W	9,672
New Jersey	55,270	63,940	119,200
New Mexico	84,740	10,010	94,750
New York	938,000	48,040	986,100
North Carolina	122,900	29,310	152,200
North Dakota	92,130	12,280	104,400
Ohio	3,447,000	148,400	3,596,000
Oklahoma	157,700	35,300	193,000
Oregon	95,910	45,140	141,000
Pennsylvania	2,101,000	249,600	2,350,000
Puerto Rico	W	W	43,970
Rhode Island	9,772	2,790	12,560
South Carolina	72,240	8,797	81,030
South Dakota	11,100	21,870	32,970
Tennessee	136,800	60,520	197,300
Texas	1,125,000	712,800	1,838,000
Utah	102,100	8,063	110,100
Virginia	163,900	40,860	204,700
Washington	134,000	65,320	199,300
West Virginia	360,500	29,860	390,400
Wisconsin	114,000	53,790	167,800
Wyoming	29,510	5,553	35,060
Other States[3]	418,300	54,900	2,267
Total United States[2]	19,044,000	2,558,000	21,603,000
Exports:			
Canada	10,250	9,280	19,530
Other countries	18,480	4,041	22,520
Total exports[2]	28,730	13,320	42,050
Grand total[2]	19,073,000	2,572,000	21,645,000

W Withheld to avoid disclosing individual company confidential data; included with "Other States."

[1] Excludes regenerated lime. Includes Puerto Rico.

[2] Data may not add to totals shown because of independent rounding.

[3] Includes Alaska, Vermont, and States indicated by symbol W.

FOREIGN TRADE

Exports of lime decreased 14% to 31,640 tons and were 54% below the 1968 record. Of the total exports, Canada received 67%, Mexico 14%, and Panama 3%. The remaining 16% went to 40 countries, listed in order of shipments: Philippines, Bahamas, Sweden, West Germany, Mozambique, Trinidad, Brazil, Republic of South Africa, Bermuda, New Zealand, El Salvador, Australia, Jamaica, the United Kingdom, Venezuela, Liberia, Nicaragua, India, Italy, United Arab Emirates, Angola, Guatemala, Haiti, Austria, Belize, the Netherlands Antilles, Indonesia, Saudi Arabia, Argentina, Honduras, Israel, Pacific Trust Islands, Bahrain, Colombia, Nigeria, Dominican Republic, Chile, Republic of South Korea, Surinam, and Japan.

Imports of lime increased 25% to a record 416,000 tons. Imports were mainly from Canada and entered the country principally through Buffalo and Detroit.

Table 7.—U.S. exports of lime

Year	Quantity (short tons)	Value (thousands)
1972	37,659	$1,242
1973	36,914	1,208
1974	31,639	1,516

Table 8.—U.S. imports for consumption of lime

Year	Hydrated lime		Other lime		Total	
	Quantity (short tons)	Value (thousands)	Quantity (short tons)	Value (thousands)	Quantity (short tons)	Value (thousands)
1972	37,468	$724	210,995	$3,224	248,463	$3,948
1973	47,309	941	286,703	4,302	334,012	5,243
1974	48,284	1,311	367,917	6,368	416,201	7,679

WORLD REVIEW

Lime is produced all over the world, mainly in the heavily industrialized countries. Source materials are abundant. The United States, with 18% of the total, ranks second in world production following the U.S.S.R.

Australia.—Broken Hill Proprietary Co., Ltd., completed a 440-ton-per-day rotary kiln lime plant at Newcastle, New South Wales. Limestone for the plant is imported from Japan. The lime will be used in the company's BOF steel mill at Newcastle.

Canada.—During 1973 there were 24 active lime plants in Canada: 10 in Ontario, 4 in Quebec, 4 in Alberta, 3 in Manitoba, 2 in British Columbia, and 1 in New Brunswick. Of the 82 kilns in operation, 55 were vertical, 23 were rotary, 3 were rotary-grate, and 1 was vibratory-grate.

Companies active in Ontario were Algoma Steel Corp., Ltd., Allied Chemical Canada, Ltd., BeachiLime Ltd., Canadian Gypsum Co. Ltd., Cyanamid of Canada Ltd., Chromasco Corp. Ltd., Domtar Chemicals Ltd., Reiss Lime Co. of Canada Ltd., the Steel Co. of Canada Ltd., and Steeley of Canada (Holdings) Ltd.

Active companies in Quebec were Dominion Lime Ltd., Domtar Chemicals Ltd., Gulf Oil Canada Ltd., and Quebec Sugar Refinery.

Three companies were active in Alberta: Canadian Sugar Factories Ltd., Steel Brothers Canada, Ltd., and Summit Lime Works Ltd. Manitoba Sugar Co. Ltd. and Steel Brothers Canada, Ltd. produced lime in Manitoba. Columbia Lime Products Ltd. and Steel Brothers Canada, Ltd. operated lime plants in British Columbia. Havelock Lime Works Ltd. operated a lime plant in New Brunswick.

Germany, West.—West Germany ranked fourth in world lime output, with 10% of production.

Japan.—Japan produced 10% of world lime output, ranking third.

Poland.—Poland produced 7% of the world's lime and ranked fifth among countries.

United Kingdom.—Amey Roadstone Corp. completed a new lime plant at Cheddar. Capacity is 500 tons per day, and the kiln is fired by liquefied petroleum gas.

U.S.S.R.—The U.S.S.R. was the leading lime-producing country in the world, with 20% of the total, compared with 18% for the United States.

Table 9.—Quicklime and hydrated lime, including dead-burned dolomite: World production by country

(Thousand short tons)

Country[1]	1972	1973	1974[p]
North America:			
Canada	[r] 1,731	1,891	2,088
Costa Rica	13	14	24
Guatemala	[e] 25	[e] 25	62
Jamaica	183	240	336
Nicaragua [e]	100	100	43
Puerto Rico	42	42	39
United States (sold or used by producers)	20,290	21,090	21,606
South America:			
Brazil [e]	2,200	2,200	2,200
Chile	NA	NA	2,862
Colombia [e]	1,100	1,100	1,100
Paraguay	27	28	30
Peru	8	[e] 11	[e] 11
Uruguay	[e] 55	53	51
Europe:			
Austria	[r] 919	874	1,145
Belgium	[r] 3,552	3,770	[e] 3,940
Bulgaria	1,047	1,026	[e] 1,030
Czechoslovakia	2,668	2,904	[e] 2,910
Denmark	219	239	189
Finland	259	257	270
France	5,330	5,461	5,767
Germany, East	3,235	3,339	[e] 3,420
Germany, West	12,030	12,386	12,358
Hungary	702	737	701
Ireland	[e] 72	84	[e] 84
Italy	2,209	2,478	2,540
Malta	65	35	[e] 33
Norway	108	104	84
Poland[2]	7,210	8,483	8,619
Portugal	320	279	241
Romania	2,684	2,858	[e] 3,090
Spain	599	377	[e] 390
Sweden	916	933	[e] 940
Switzerland	165	152	125
U.S.S.R. [e]	24,000	24,000	24,000
Yugoslavia	[r] 1,888	2,061	[e] 1,750
Africa:			
Algeria [e]	44	44	44
Burundi	(3)	[e] (3)	[e] (3)
Egypt, Arab Republic of	55	90	[e] 90
Ethiopia[4]	52	[e] 53	[e] 53
Kenya	25	35	[e] 35
Libya	NA	NA	22
Mauritius	7	[r] [e] 8	4
Malawi [e]	(3)	(3)	(3)
Mozambique	8	11	6
South Africa, Republic of (sales)	1,317	1,460	[e] 1,250
Tanzania	2	7	6
Tunisia	[r] 174	206	[e] 125
Uganda [e]	[r] 33	[r] 33	33
Zaire [e]	[r] 120	165	165
Zambia [e]	115	120	120
Asia:			
Cyprus	[r] 92	98	68
India	373	[e] 375	[e] 375
Iran [e]	1,100	1,100	1,100
Israel	198	[e] 200	221
Japan	11,166	13,024	12,362
Jordan	2	3	3
Korea, Republic of [e]	96	96	96
Kuwait	2	(3)	[e] (3)
Lebanon	[e] 132	168	195
Mongolia [e]	45	45	45
Nepal	NA	NA	(3)
Philippines	312	166	111
Saudi Arabia	14	[e] 17	[e] 17
Taiwan	[r] 216	194	171

See footnotes at end of table.

Table 9.—Quicklime and hydrated lime, including dead-burned dolomite: World production by country—Continued

(Thousand short tons)

Country [1]	1972	1973	1974 [p]
Oceania:			
Australia [5]	848	[r] [e] 850	[e] 850
Fiji Islands	4	3	--
Total	[r] 112,523	118,197	121,640

[e] Estimate. [p] Preliminary. [r] Revised. NA Not available.

[1] Lime is produced in many other countries besides those listed. Mexico, Venezuela, and the United Kingdom are among the more important countries for which official data are unavailable.

[2] Excludes output by small producers.

[3] Less than ½ unit.

[4] Figures for 1972 and 1973 include production in Eritrea.

[5] Year ending June 30 of that stated.

TECHNOLOGY

The high price of fuels has resulted in increased interest in the use of preheaters for limekilns. Several installations have been made in Europe. Substantial savings in energy are claimed; compared with average kilns, heat requirements are reduced from 6 million to 4 million Btu per ton of lime.

Magnesium

By E. Chin [1]

World production capacity for magnesium was expected to increase substantially by 1980 owing to expansion of existing plants and construction of new ones. The Dow Chemical Co. announced plans for expanding its magnesium production capacity at Freeport, Tex., as well as constructing a new magnesium-metal facility. American Magnesium Co., at Snyder, Tex., was expected to complete installation of additional electrolytic cells by 1979. Northwest Alloys, Inc., was scheduled to begin magnesium production in late 1975 at Addy, Wash. In Japan, Showa Denko K.K. was constructing a facility to test a new thermal magnesium process, and in Norway, Norsk Hydro-Elektrisk A/S was constructing a pilot plant to test a new process for producing anhydrous magnesium chloride.

During 1974, there were four domestic price increases for magnesium metal. At the beginning of the year, the price of metal was 41.25 cents per pound. By yearend, it had risen to 75.00 cents per pound, with another announced price rise scheduled to take effect on January 1, 1975.

Domestic production of primary magnesium metal in 1974 was by the American Magnesium Co., Snyder, Tex.; The Dow Chemical Co., Freeport, Tex.; and NL Industries, Inc., Rowley, Utah. Data on U.S. production and shipments of magnesium metal are not published to avoid disclosing individual company confidential data.

Legislation and Government Programs.—In 1970, the Office of Preparedness removed magnesium metal from the list of strategic and critical materials, and the stockpile objective for magnesium was abolished. Under authority of Public Laws 90-604, 91-321, and 92-113, the General Services Administration (GSA) began disposing of all the magnesium remaining in the Government stockpile. A total of 20,981 short tons was sold during 1974 compared with 66,638 short tons sold in 1973.

Table 1.—Salient magnesium statistics
(Short tons)

	1970	1971	1972	1973	1974
United States:					
Production:					
Primary magnesium	112,006	123,485	120,823	122,431	W
Secondary magnesium	12,042	14,703	15,628	17,636	14,874
Shipments: Primary	118,693	120,217	111,185	137,277	W
Exports	35,732	24,311	17,556	39,585	46,398
Imports for consumption	3,295	3,671	4,479	[r] 3,325	5,305
Consumption	93,495	92,166	103,691	115,774	130,048
Price per pound cents	35.25	36.25	37.25	38.25	41.25-75.00
World: Primary production	242,253	255,753	[r] 257,529	[r] 266,441	NA

[r] Revised. NA Not available. W Withheld to avoid disclosing individual company confidential data.

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[1] Physical scientist, Division of Nonferrous Metals.

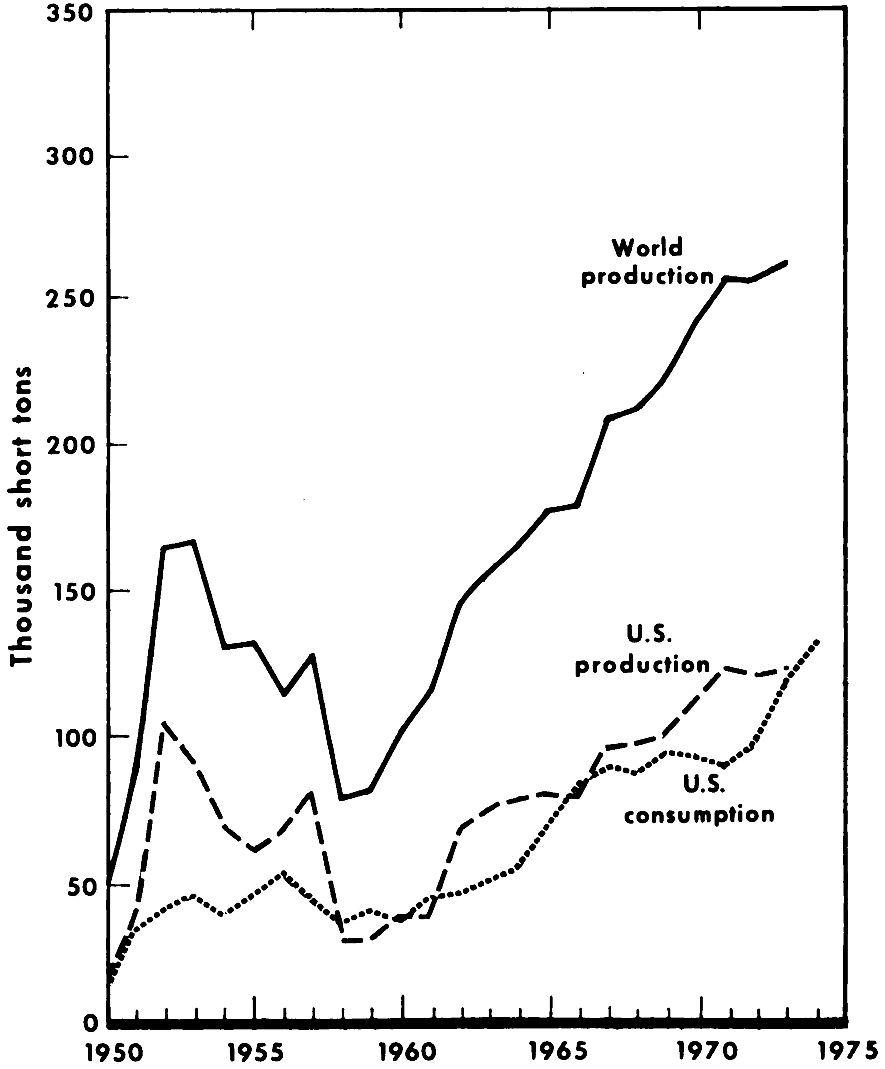

Figure 1.—U.S. and world production and U.S. consumption of primary magnesium.

DOMESTIC PRODUCTION

The Dow Chemical Co. announced an expansion program for producing magnesium metal at its plant in Freeport, Tex. Plant capacity was scheduled to be increased from 120,000 short tons per year to 135,000 short tons per year by 1978. Additionally, Dow Chemical announced its intention to construct a new magnesium-metal plant with a capacity of 50,000 short tons per year of metal. The site for the new facility was not announced, but completion is expected in 1980.

The electrolytic plant of American Magnesium Co., Snyder, Tex., had a capacity of 10,000 short tons of metal in 1974. The final addition of 20,000 tons was expected to be completed in 1979.

Northwest Alloys, Inc., a subsidiary of the Aluminum Co. of America (Alcoa), was constructing a magnesium facility at Addy, Wash. Startup of this plant, with an initial capacity of 24,000 tons per year of magnesium, was scheduled for 1975–76. The installation of additional capacity of 16,000 tons per year of metal was to be completed in 1980.

Table 2.—Magnesium recovered from scrap processed in the United States, by kind of scrap and form of recovery
(Short tons)

	1970	1971	1972	1973	1974 P
Kind of scrap:					
New scrap:					
Magnesium-base	4,564	6,722	6,993	7,417	3,357
Aluminum-base	4,698	4,838	5,646	6,118	5,798
Total	9,262	11,560	12,639	13,535	9,155
Old scrap:					
Magnesium-base	1,518	1,719	1,445	2,529	4,161
Aluminum-base	1,262	1,424	1,544	1,572	1,558
Total	2,780	3,143	2,989	4,101	5,719
Grand total	12,042	14,703	15,628	17,636	14,874
Form of recovery:					
Magnesium alloy ingot[1]	2,006	3,905	3,612	2,606	2,703
Magnesium alloy castings (gross weight)	13	14	9	12	14
Magnesium alloy shapes	189	500	275	169	4
Aluminum alloys	7,088	7,423	8,790	9,206	9,316
Zinc and other alloys	24	17	14	31	16
Chemical and other dissipative uses	80	478	794	567	44
Cathode protection	2,642	2,366	2,134	5,045	2,777
Total	12,042	14,703	15,628	17,636	14,874

P Preliminary.

[1] Includes secondary magnesium content of both secondary and primary magnesium alloy ingot.

CONSUMPTION AND USES

Consumption of magnesium in the United States rose to 130,048 short tons in 1974. Magnesium was consumed in two broad categories: Structural products, such as castings and wrought products; and distributive or sacrificial applications, where advantage is taken of the chemical properties of the metal. Useful structural properties of magnesium include low specific weight, good machinability, hot formability, and high strength. The principal structural applications, which accounted for about 24% of the total use, were in aircraft, automotive, and other types of transportation equipment; materials handling; and power tools, such as powersaws and lawnmowers. The remainder of the consumption was for sacrificial uses, primarily alloying with other metals (especially aluminum), cathodic protection, production of nodular iron and desulfurization of steel, and as a reducing agent in the production of titanium, beryllium, and other metals.

Table 3.—Consumption of primary magnesium in the United States, by use

(Short tons)

	1970	1971	1972	1973 r	1974 p
For structural products:					
Castings:					
Die	9,002	7,469	9,326	9,999	11,804
Permanent mold	260	142	736	812	1,000
Sand	1,735	765	700	1,326	1,372
Wrought products:					
Extrusions	12,250	5,587	7,749	7,436	7,323
Sheet and plate	(1)	2,918	3,817	(2)	(2)
Other (including forgings)	(1)	2,212	1,381	5,529	6,025
Total	23,247	19,093	23,709	25,102	27,524
For distributive or sacrificial purposes:					
Alloys:					
Aluminum	36,543	37,450	43,458	51,953	62,152
Copper	(2)	163	38	503	19
Zinc	35	24	28	30	24
Other	(2)	37	109	13	16
Cathodic protection (anodes)	5,778	7,296	6,543	9,931	10,439
Chemical	8,385	8,960	9,732	9,835	9,204
Nodular iron	4,720	6,590	7,603	8,724	10,603
Powder	5,646	(2)	(2)	(2)	(2)
Scavenger and deoxidizer	(2)	68	327	50	285
Reducing agent for titanium, zirconium, hafnium, uranium, and beryllium	6,300	9,053	6,089	7,367	7,569
Other	2,841	3,432	6,055	2,266	2,213
Total	70,248	73,073	79,982	90,672	102,524
Grand total	93,495	92,166	103,691	115,774	130,048

p Preliminary. r Revised.

[1] Included with "Extrusions."

[2] Included with "Other."

PRICES

Throughout 1973, the quoted base price for primary magnesium pig and ingot in 10,000-pound lots, 99.8% magnesium f.o.b. plant, was 38.25 and 39.00 cents per pound, respectively. During 1974, the changes in the quoted price for magnesium metal were as follows:

Effective date	Cents per pound
January 1	41.25
March 11	47.00
May 1	55.00
July 1	65.00
August 1	75.00

Effective January 1, 1975, the price of magnesium will be raised 7 cents to 82 cents per pound.

STOCKS

Producer and consumer stocks of primary magnesium totaled 21,106 short tons as of December 31, 1974. Yearend stocks of primary magnesium alloy ingot were 1,677 tons. Stocks at yearend 1973 were 17,188 short tons of primary metal and 1,706 tons of alloy ingot.

Table 4.—Stocks and consumption of new and old magnesium scrap in the United States in 1974

(Short tons)

Item	Stocks Jan. 1 r	Receipts	Consumption			Stocks Dec. 31
			New scrap	Old scrap	Total	
Cast scrap	455	6,395	676	5,082	5,758	1,092
Solid wrought scrap[1]	306	423	549	--	549	180
Total	761	6,818	1,225	5,082	6,307	1,272

r Revised.

[1] Includes borings, turnings, drosses, etc.

FOREIGN TRADE

U.S. exports of magnesium increased from 39,585 short tons valued at $28.2 million in 1973 to 46,398 tons valued at $48.5 million in 1974. Shipments to Brazil, Canada, West Germany, Japan, Mexico, and the Netherlands accounted for 78% of the total U.S. magnesium exports. The remaining 10,358 tons was exported to 23 other countries. Approximately 96% of all the magnesium exported was in the form of primary metal and alloys.

Total magnesium imports for consumption increased from 3,325 short tons valued at $2.7 million to 5,305 tons valued at $5.2 million. Imports of waste and scrap accounted for 81% of the total imports of magnesium. West Germany, the largest U.S. source, contributed 22% of the metal imported. Receipts from the Netherlands and Canada constituted 21% and 16% of the magnesium imports, respectively. The remainder of U.S. imports, 2,181 tons, was contributed by 18 other nations.

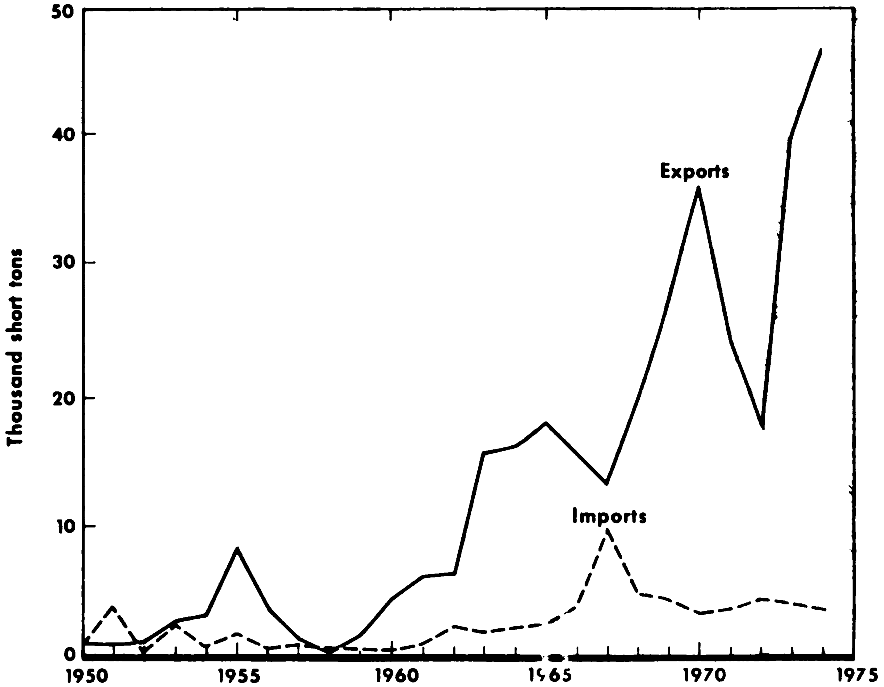

Figure 2.—U.S. imports and exports of magnesium.

Table 5.—U.S. exports of magnesium, by class and country

Destination	1973						1974					
	Waste and scrap		Primary metals, alloys		Semifabricated forms, n.e.c., including powder		Waste and scrap		Primary metals, alloys		Semifabricated forms, n.e.c., including powder	
	Quantity (short tons)	Value (thousands)	Quantity (short tons)	Value (thousands)	Quantity (short tons)	Value (thousands)	Quantity (short tons)	Value (thousands)	Quantity (short tons)	Value (thousands)	Quantity (short tons)	Value (thousands)
Angola	--	--	4	$5	--	--	--	--	--	--	--	--
Argentina	--	--	334	315	6	$47	--	--	427	$671	5	$41
Australia	--	--	356	245	242	193	--	--	540	738	11	41
Austria	--	--	22	19	5	9	--	--	--	--	8	21
Belgium-Luxembourg	12	$4	167	104	1	3	--	--	--	--	(1)	2
Brazil	--	--	6,548	4,365	--	--	(1)	$1	6,101	6,305	1	10
Canada	10	44	5,189	3,374	243	454	41	103	6,828	7,379	136	334
Colombia	--	--	14	18	--	--	--	--	28	40	1	2
Egypt	--	--	1	(1)	--	--	--	--	22	21	--	--
France	--	--	335	222	4	14	39	52	385	341	11	69
Germany, West	--	--	7,185	4,727	167	383	17	73	6,226	7,150	531	1,683
Ghana	--	--	804	521	--	--	--	--	525	1,019	2	1
India	--	--	139	92	2	2	--	--	130	166	--	--
Indonesia	--	--	50	51	--	--	--	--	26	58	--	--
Israel	--	--	18	19	125	166	--	--	68	44	82	242
Italy	--	--	1,053	734	9	30	59	27	524	554	2	12
Japan	7	2	3,509	2,655	340	739	--	--	4,388	4,384	246	506
Mexico	12	17	3,271	2,174	9	17	2	3	5,489	5,393	10	17
Netherlands	--	--	5,966	3,846	22	52	--	--	5,991	4,396	33	84
Netherlands Antilles	--	--	--	--	--	--	--	--	334	255	1	1
New Zealand	--	--	22	18	--	--	--	--	100	111	2	3
Norway	--	--	523	341	(1)	1	--	--	1,532	1,279	1	2
South Africa, Republic of	--	--	594	480	3	4	--	--	575	662	--	--
Spain	--	--	686	418	4	10	--	--	544	408	19	52
Switzerland	--	--	29	17	15	36	--	--	34	29	--	--
Taiwan	--	--	155	121	(1)	1	644	102	369	411	5	13
Turkey	--	--	15	11	--	--	--	--	110	90	--	--
United Kingdom	--	--	686	514	12	38	--	--	2,645	2,298	37	170
Venezuela	--	--	407	336	--	--	--	--	346	387	(1)	3
Other	3	14	241	197	9	28	1	4	153	188	11	60
Total	44	81	38,323	25,984	1,218	2,227	803	365	44,440	44,777	1,155	3,369

[1] Less than ½ unit.

Table 6.—U.S. exports and imports for consumption of magnesium

Year	Exports					
	Waste and scrap		Metals and alloys in crude form		Semifabricated forms, n.e.c.	
	Quantity (short tons)	Value (thousands)	Quantity (short tons)	Value (thousands)	Quantity (short tons)	Value (thousands)
1972	94	$116	16,642	$10,132	820	$1,454
1973	44	81	38,323	25,934	1,218	2,227
1974	803	365	44,440	44,777	1,155	3,369

Year	Imports							
	Waste and scrap		Metal		Alloys (magnesium content)		Powder, sheets, tubing, ribbons, wire, other forms (magnesium content)	
	Quantity (short tons)	Value (thousands)	Quantity (short tons)	Value (thousands)	Quantity (short tons)	Value (thousands)	Quantity (short tons)	Value (thousands)
1972	3,042	$1,040	1,256	$950	168	$464	13	$103
1973	2,296	952	r 620	r 485	389	1,104	20	129
1974	4,320	2,826	495	692	440	1,573	50	135

r Revised.

WORLD REVIEW

World production of magnesium metal in 1974, excluding U.S. production, was 140,989 short tons. The U.S.S.R. produced 47% of the world magnesium output (excluding U.S. production), followed by Norway (30%), and Japan (7%). The remainder of the world production was by Canada, the People's Republic of China, France, and Italy.

World producers of magnesium in 1974 with annual capacities, processes, and plant locations were as follows:

Country	Company	Capacity (short tons)	Process	Plant location
Canada	Chromasco Corporation Limited.	12,000	Silicothermic	Haley, Ontario.
China, People's Republic of	NA	5,000	do	Ying-kou, Liaoning.
France	Société Générale du Magnesium (owned by Péchiney Ugine Kuhlmann S.A., 70%, and Société des Produits Azotes, 30%).	11,000	do	Marignac.
Italy	Societá Italiana per il Magnesio e Leghe di Magnesio.	12,000	do	Bolzano.
Japan	Furukawa Magnesium Co	7,000	do	Koyama.
	UBE Industries, Ltd	5,500	do	Yamaguchi.
Norway	Heroya Electrokemiske Fabbrikker A/S (subsidiary of Norsk Hydro-Elektrisk A/S).	44,000	I.G. Farben-industrie.	Heroya.
U.S.S.R	NA	50,000	Electrolytic	NA.
United States	American Magnesium Co	10,000		Snyder, Tex.
	The Dow Chemical Co	120,000	Dow cells	Freeport, Tex.
	NL Industries, Inc	45,000	Electrolytic	Rowley, Utah.

NA Not available.

Table 7.—Magnesium: World production,[1] by country
(Short tons)

Country	1972	1973	1974 [p]
Canada	5,924	6,840	6,534
China, People's Republic of [e]	1,100	1,100	1,100
France	[r] 7,549	9,511	7,202
Italy	[r] 9,980	9,850	8,157
Japan [2]	12,004	12,349	9,836
Norway	[r] 40,149	41,360	42,160
U.S.S.R.[e]	60,000	63,000	66,000
United States	[3] 120,823	[3] 122,431	W
Total	[r] 257,529	266,441	NA

[e] Estimate. [p] Preliminary. [r] Revised. NA Not available. W Withheld to avoid disclosing individual company confidential data.
[1] Primary only.
[2] Secondary production was as follows, in short tons: 1972—5,612; 1973—8,936; and 1974 (preliminary)—11,990.
[3] The Dow Chemical Co. only.

Japan.—Showa Denko K.K. was constructing a pilot plant at Chickibu, Sartama, to test a new patented thermal magnesium process. The plant was planned to have a capacity of 440,000 pounds per year of magnesium. The startup date was not announced.

Norway.—Norsk Hydro-Elektrisk A/S reportedly developed a new process for producing anhydrous magnesium chloride. The process will be tested on an industrial scale at a plant being constructed at the Porsgrun Fabrikker facility at Heroya. If successful, this production will add 16,500 short tons to the existing metal capacity at Heroya.

TECHNOLOGY

A technique for the reduction of thorium dioxide using a magnesium-zinc alloy was described.[2] The present commercial method for the production of thorium metal involves the metallothermic reduction of thorium tetrafluoride with calcium in the presence of zinc chloride. Using a magnesium-zinc alloy as a reductant for thoria has the following potential economic advantages. Relatively inexpensive reagents are used for the metal and flux phases; and metal of acceptable quality can be produced with good yields.

The Nation's largest college ring maker began marketing a new alloy, called "siladium," for use in jewelry.[3] The alloy, which contains palladium, nickel, and magnesium, reportedly is tough and durable and does not tarnish.

A diving suit weighing 910 pounds was developed using magnesium castings that are sealed and then painted.[4] A constant pressure is maintained within the suit, thus eliminating the problems and dangers of normal compression and decompression. The suit was qualified for operating at a depth of 640 feet, but was tested at 2,000 feet.

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[2] Light Metal Age. Thorium Reduction by Magnesium Zinc. V. 32, No. 1-2, February 1974, p. 14.
[3] Sizemore, R. C. Top College Ring Maker Turning to Siladium to Counter Gold Cost. Am. Metal Market, v. 81, No. 45, Mar. 6, 1974, p. 12.
[4] Modern Metals. Magnesium Suit for World's Best Dressed Diver. V. 29, No. 12, January 1974, pp. 82-84.

Articles describing various techniques to produce ductile iron with magnesium were published.[5] Included in the discussions were the use of new magnesium alloy compositions, plunging techniques to allow the reacting magnesium to mix with the liquid iron, and the reduction of solids emissions.

Patents on the production of magnesium metal from dolomite and on the removal of magnesium chloride from carnallite were issued.[6]

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[5] Foundry. Nodularization in the Mold Offers Advantages. V. 102, No. 4, April 1974, pp. 68–70.

———. Operations Roundup. V. 102, No. 8, August 1974, p. 69.

———. The Pont-a-Mousson Process for Ductile Iron. V. 102, No. 9, September 1974, pp. 86, 88, 91.

———. Converts Iron from Small Ductile Castings. V. 102, No. 9, September 1974, pp. 74–76, 78, 80.

Modern Metals. Unveil Mag-Based Steel/Iron Agents. V. 30, No. 7, August 1974, pp. 126–127.

[6] Avery, J. M. Aluminothermic Production of Magnesium and an Oxidic Slag Containing Recoverable Alumina. U.S. Pat. 3,782,922, Jan. 1, 1974.

Dancy, W. B. (assigned to International Minerals & Chemical Corp.). Integrated System for Recovering Magnesium Chloride and Potassium Chloride From a Subsurface Deposit of Carnallite. Can. Pat. 949,755, June 25, 1974.

Mulcihy, T. W. (assigned to Dow Chemical Co.). Method and Apparatus for Producing Magnesium Metal in Large Quantities at a Reduced Cost Per Unit Produced. U.S. Pat. 3,823,003, July 9, 1974.

Pons, R., M. Poyet, J. Desbert, and A. Mena (assigned to Ste. Francais d'Electrometallurgie). Thermal Production of Magnesium From Calcined Dolomite. U.S. Pat. 3,837,843, Sept. 24, 1974.

Magnesium Compounds

By E. Chin [1]

World production of magnesite in 1974, excluding output in the United States, was 10,194,845 short tons, slightly more than that in 1973. Magnesite production in Austria, Greece, North Korea, the People's Republic of China, and the U.S.S.R. accounted for 73% of the world total.

The increasing worldwide trend toward greater production of magnesium compounds from seawater, well and lake brines, and dry lake deposits continued to exert competitive pressure on producers of magnesite. During 1974, two domestic companies, one using seawater as a raw material source and the other using well brines, completed expansions of production capacity for magnesium compounds. A Norwegian firm announced plans to produce magnesium hydroxide from seawater near the Arctic Circle.

Refractory magnesia and caustic-calcined and specified magnesias, sold or used by domestic producers in 1974, were 1.4% below those in 1973. However, the value of domestic shipments of magnesias rose 8% to $104,960,000 in 1974.

Exports of magnesite and magnesia were 62,000 tons in 1974, and as in 1970–73, the shipments were primarily to Canada. U.S. imports for consumption of processed magnesite in 1974 were 156,401 short tons, with Greece supplying 35% of the total.

Table 1.—Salient magnesium compound statistics
(Thousand short tons and thousand dollars)

	1970	1971	1972	1973	1974
United States:					
Caustic-calcined and specified magnesias: [1]					
Shipments by producers:					
Value	122	127	128	158	149
Quantity	19,301	18,621	15,856	26,929	27,916
Exports: Value [2]	3,200	2,840	3,377	4,196	5,088
Imports for consumption [2]					
Value	702	736	675	734	692
Refractory magnesia:					
Sold and used by producers:					
Quantity	802	627	696	807	803
Value	60,333	50,859	60,331	r 69,904	77,044
Exports: Value	9,133	5,897	5,903	6,104	7,749
Imports: Value	7,857	9,219	9,300	r 13,469	16,463
Dead-burned dolomite:					
Sold and used by producers:					
Quantity	1,873	r 1,007	r 1,075	r 1,250	p 1,300
Value	25,740	r 18,883	r 20,158	r 23,441	p 24,378
World: Crude magnesite production:					
Quantity	9,763	10,061	r 9,884	r 9,994	10,195

p Preliminary. r Revised.
[1] Excludes caustic-calcined magnesia used in production of refractory magnesia.
[2] Caustic-calcined magnesia only.

DOMESTIC PRODUCTION

Magnesium hydroxide was produced from seawater and well brines by Barcroft Co., Basic Magnesia, Inc., Corhart Refractories, Co., Inc., The Dow Chemical Co., FMC Corporation, Harbison-Walker

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[1] Physical scientist, Division of Nonferrous Metals.

Refractories, Kaiser Aluminum & Chemical Corp., Martin Marietta Chemicals, Merck & Co., Inc., Michigan Chemical Corp., and Morton Chemical Co. Most of the magnesium hydroxide produced was used in the production of magnesia for basic refractories. Producers of refractory magnesia were Basic, Inc., Basic Magnesia, Inc., Corhart Refractories Co., Inc., A. P. Green Refractories Co., Harbison-Walker Refractories, Kaiser Aluminum & Chemical Corp., and Martin Marietta Chemicals. Total production of refractory magnesia in 1974 was 779,554 tons.

Caustic-calcined magnesia was produced by Basic, Inc., Basic Magnesia, Inc., The Dow Chemical Co., Kaiser Aluminum & Chemical Corp., Martin Marietta Chemicals, and Michigan Chemical Corp. Total production of caustic-calcined magnesia was 224,518 tons in 1974. Merck & Co., Inc., Michigan Chemical Corp., and Morton Chemical Co. produced 13,065 tons of specified magnesia. The Dow Chemical Co., Giles Chemical Corp., and Philadelphia Quartz Co. produced 70,237 tons of magnesium sulfate (anhydrous and hydrous). During the year 11,150 tons of magnesium carbonate were produced by Merck & Co., Inc., Michigan Chemical Corp., and Morton Chemical Co.

Magnesium chloride was produced by American Magnesium Co., The Dow Chemical Co., FMC Corporation, Great Salt Lake Minerals & Chemicals Corp., Kaiser Aluminum & Chemical Corp., and NL Industries, Inc. Most of the magnesium chloride production was used for magnesium metal cell feed.

Domestic producers of magnesium compounds by raw material source, location, and capacity follow:

Raw material source and producing company	Location	Capacity (short tons MgO equivalent)
Magnesite: Basic, Inc	Gabbs, Nev	150,000
Lake brines:		
Great Salt Lake Minerals & Chemicals Corp	Ogden, Utah	100,000
Kaiser Aluminum & Chemical Corp	Wendover, Utah	50,000
Well brines:		
The Dow Chemical Co	Ludington, Mich	250,000
Martin Marietta Chemicals	Manistee, Mich	280,000
Michigan Chemical Corp	St. Louis, Mich	25,000
Morton Chemical Co	Manistee, Mich	5,000
Seawater:		
Barcroft Co	Lewes, Del	5,000
Basic Magnesia, Inc	Port St. Joe, Fla	100,000
Cohart Refractories Co., Inc	Pascagoula, Miss	40,000
The Dow Chemical Co	Freeport, Tex	100,000
FMC Corporation	Chula Vista, Calif	5,000
Harbison-Walker Refractories	Cape May, N.J	100,000
Kaiser Aluminum & Chemical Corp	Moss Landing, Calif	150,000
Merck & Co., Inc	South San Francisco, Calif	10,000
Total		1,870,000

CONSUMPTION AND USES

In 1974, magnesia used in the production of basic refractories was 802,673 tons, slightly less than that in 1973. Consumption of caustic-calcined and specified magnesias for uses other than the production of refractory magnesia decreased significantly from that of 1973.

Magnesia was used as a fuel additive in burning heavy fuel at steam-generating plants to prevent corrosion and acid smut fallout. It also was used for stack gas scrubbing. As an additive to animal feed, magnesia prevents grass tetany in cattle and sheep, promotes increased egg laying, and increases the butterfat content of milk. In sugar cane processing mills, magnesia prevents scale formation in the evaporators. As an additive in rubber, magnesia is used to neutralize acidity, to keep the molds cleaner, and to improve the rubber cure rate. Other uses for magnesia are in chemicals, construction materials such as plaster and cement, cosmetics, electrical heating rods, fertilizers, medicinals and pharmaceuticals, and pulp and paper.

Other magnesium compounds were used in candy, wine, and water processing, in tannery applications, and in cosmetics and pharmaceuticals.

Table 2.—Magnesium compounds shipped and used in the United States

Year and product	Shipped and used	
	Quantity (short tons)	Value (thousands)
1973		
Caustic-calcined[1] and specified (U.S.P. and technical) magnesias	157,668	$26,929
Refractory magnesia	806,548	69,904
Magnesium hydroxide (100% $Mg(OH)_2$)[1]	83,324	4,857
Magnesium sulfate (anhydrous and hydrous)	63,011	4,551
Precipitated magnesium carbonate[1]	5,036	1,746
1974		
Caustic-calcined[1] and specified (U.S.P. and technical) magnesias	148,827	27,916
Refractory magnesia	802,673	77,044
Magnesium hydroxide (100% $Mg(OH)_2$)[1]	93,057	5,618
Magnesium sulfate (anhydrous and hydrous)	65,062	6,281
Precipitated magnesium carbonate[1]	5,903	2,161

[1] Excludes material produced as an intermediate step in the manufacture of other magnesium compounds.

Table 3.—Domestic shipments of caustic-calcined and specified magnesias, by use
(Short tons)

Use	1973	1974
Agriculture, nutrition, and pharmaceuticals:		
Animal feed	(1)	W
Fertilizer	33,992	9,629
Medicinals and pharmaceuticals	W	2,620
Sugar and candy	4,939	3,716
Winemaking		W
Total	38,931	39,674
Construction materials:		
Insulation and wallboard	(2)	(2)
Oxychloride and oxysulfate cement	19,441	19,275
Total	19,441	19,275
Chemical processing, manufacturing, and metallurgical:		
Chemical	41,264	13,874
Electrical heating rods	2,852	12,166
Flux	--	W
Petroleum additive	W	12,075
Pulp and paper	13,760	16,355
Rayon	12,145	14,170
Rubber	11,893	8,526
Stack gas scrubbing	NA	W
Uranium processing	W	W
Water treatment	W	W
Total	84,409	80,838
Unspecified uses	14,887	9,040
Grand total	157,668	148,827

NA Not available. W Withheld to avoid disclosing individual company confidential data; included with "Total."

[1] Included with "Fertilizer."

[2] Included with "Oxychloride and oxysulfate cement."

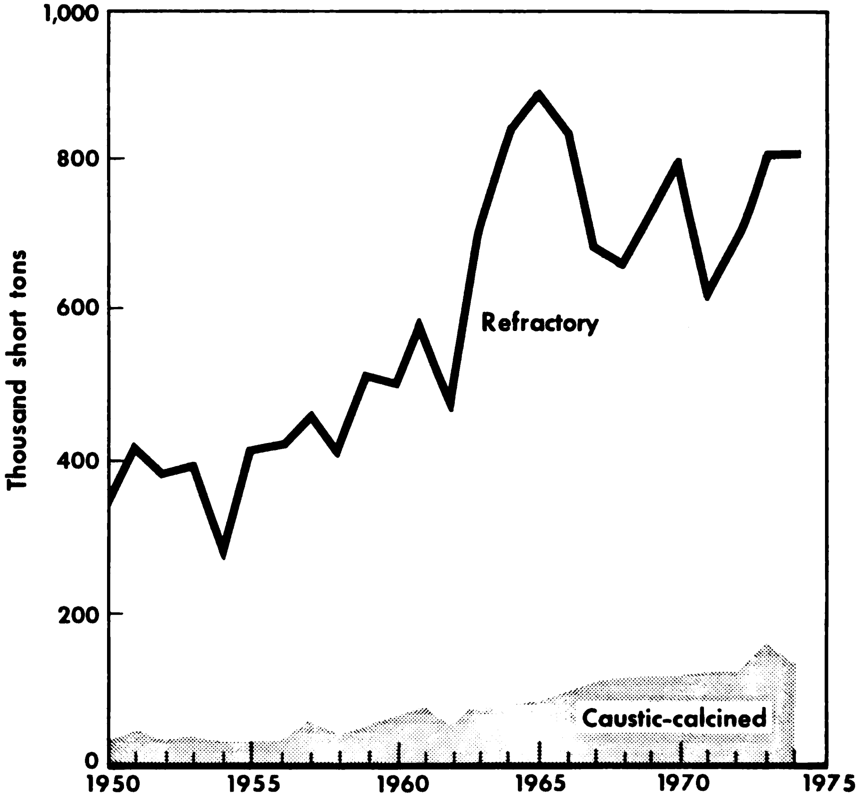

Figure 1.—Consumption and shipments of magnesia in the United States.

PRICES

The price for magnesia, natural, technical, heavy, 85% and 90% (bulk, carlot, truckload, f.o.b. Luning, Nev.) was quoted at yearend at $85 and $105 per short ton, respectively, according to the Chemical Marketing Reporter. Magnesia, technical, neoprene-grade, light, was quoted at $346 per ton (bags, carlot, truckload, works).

Prices throughout the year for magnesium carbonate, technical (bags, carlot, freight-equalized), remained the same as in 1973 at $0.16 per pound; prices for truckload quantities at $0.18 to $0.185 per pound were also unchanged. During the year, the price for magnesium hydroxide, NF, powder (drums, carlot, and truckload, works) was $0.30 per pound. Magnesium chloride, hydrous, 99%, flakes, bags, carlot, works, was quoted at $120 per ton.

The price for magnesium sulfate (technical, bags, mixed carlot, 10,000-pound minimum, works) was quoted at $0.05 per pound.

FOREIGN TRADE

Exports of dead-burned magnesite and magnesia in 1974 totaled 51,267 tons compared with 50,760 tons in 1973. Exports to the principal destination, Canada, were 39,649 tons, 7% lower than in 1973. However, shipments to the Netherlands and West Germany were substantially higher than in 1973.

Exports of magnesite, including crude, caustic-calcined, lump or ground, increased over exports in 1973 and totaled 10,733 tons. Deliveries to Australia, Canada, the United Kingdom, Venezuela, and West Germany accounted for over 62% of the exports in this class.

Imports of lump or ground caustic-calcined magnesia decreased 18% in 1974 to 8,990 tons. Receipts from India and Turkey accounted for over 86% of the imports in this class.

Imports of dead-burned and grain magnesia and periclase containing a maximum of 4% lime decreased 12% to 131,978 tons. Imports for the same class of material but containing over 4% lime increased from 8,956 tons in 1973 to 24,423 tons in 1974. Total imports of crude and processed magnesite decreased 2% from those in 1973 to 165,391 short tons.

Imports of specified magnesium compounds and compounds not specifically provided for, were valued at $2,107,000 in 1974 compared with $1,880,000 in 1973.

Table 4.—U.S. exports of magnesite and magnesia, by country

Destination	Magnesite and magnesia, dead-burned				Magnesite, n.e.c., including crude caustic-calcined, lump or ground			
	1973		1974		1973		1974	
	Quantity (short tons)	Value (thousands)	Quantity (short tons)	Value (thousands)	Quantity (short tons)	Value (thousands)	Quantity (short tons)	Value (thousands)
Argentina	7	$1	--	--	119	$60	145	$93
Australia	21	14	42	$4	976	470	752	504
Belgium-Luxembourg	--	--	3	1	73	35	58	31
Brazil	31	14	18	12	168	79	281	120
Canada	42,540	4,477	39,649	5,016	1,771	762	2,635	782
Chile	864	86	501	59	6	3	33	14
Colombia	--	--	16	14	42	23	61	39
Costa Rica	--	--	--	--	2	1	4	3
Denmark	--	--	--	--	13	6	34	15
El Salvador	5	2	--	--	--	--	--	--
Finland	1	1	--	--	335	197	145	87
France	98	8	--	--	347	209	524	306
Germany, West	3,108	524	5,542	1,016	1,377	719	1,386	756
Honduras	40	6	--	--	--	--	1	2
Israel	8	4	--	--	33	17	41	24
Italy	--	--	--	--	946	206	521	265
Japan	185	29	66	36	48	20	147	115
Korea, Republic of	--	--	--	--	5	2	42	17
Mexico	858	87	15	9	610	214	34	21
Netherlands	1,638	239	3,558	650	202	82	270	255
New Zealand	5	4	--	--	293	130	235	172
Peru	--	--	--	--	11	5	12	5
Philippines	45	15	181	70	38	21	203	81
South Africa, Republic of	129	93	274	139	154	85	117	75
Spain	--	--	6	4	186	77	286	120
Sweden	82	66	90	78	464	296	501	335
Switzerland	--	--	55	16	74	30	63	29
Taiwan	66	11	261	87	32	10	71	34
U.S.S.R	221	66	652	310	--	--	--	--
United Kingdom	469	299	238	197	514	290	748	415
Venezuela	267	41	30	6	280	40	1,184	249
Yugoslavia	--	--	--	--	68	45	80	56
Other	72	17	70	25	117	62	119	68
Total	50,760	6,104	51,267	7,749	9,304	4,196	10,733	5,088

Table 5.—U.S. imports for consumption of crude and processed magnesite, by country

Country	1973 Quantity (short tons)	1973 Value (thousands)	1974 Quantity (short tons)	1974 Value (thousands)
Lump or ground caustic-calcined magnesia:[1]				
Australia	172	$15	242	$38
Austria	121	7	60	3
Canada	--	--	92	15
India	7,885	435	5,476	296
Japan	221	17	--	--
Malaysia	--	--	220	10
Netherlands	302	36	616	67
Turkey	2,246	222	2,284	263
United Kingdom	20	2	--	--
Total	10,967	734	8,990	692
Dead-burned and grain magnesia and periclase:				
Not containing lime or not over 4% lime:				
Australia	r 1,322	r 170	882	118
Austria	4,568	354	12,575	1,366
Brazil	2,752	163	--	--
Canada	30	7	56	14
Greece	66,746	6,322	54,419	7,311
Ireland	33,226	2,744	42,298	5,331
Italy	6,837	820	2,772	300
Japan	26,805	2,325	2,216	181
United Kingdom	6,982	564	12,607	1,445
Yugoslavia	--	--	4,153	397
Total	r 149,268	r 13,469	131,978	16,463
Containing over 4% lime:				
Austria	--	--	1,411	145
Canada	2,056	84	5,601	334
Greece	1,990	98	3,968	511
Japan	--	--	1	1
Yugoslavia	4,910	260	13,442	1,001
Total	8,956	442	24,423	1,992
Total dead-burned, grain magnesia and periclase	r 158,224	r 13,911	156,401	18,455

r Revised.

[1] In addition, 19 short tons ($1,396) of crude magnesite, from India.

Table 6.—U.S. imports for consumption of magnesium compounds

Year	Oxide or calcined magnesia		Magnesium carbonate (precipitated)[1]		Magnesium chloride (anhydrous)		Magnesium chloride (other)		Magnesium sulfate (epsom salts and kieserite)		Magnesium salts and compounds n.s.p.f.[2]	
	Quantity (short tons)	Value (thousands)	Quantity (short tons)	Value (thousands)	Quantity (short tons)	Value (thousands)	Quantity (short tons)	Value (thousands)	Quantity (short tons)	Value (thousands)	Quantity (short tons)	Value (thousands)
1972	690	$256	139	$73	22	$1	250	$8	21,538	$378	2,662	$395
1973	673	292	138	88	121	45	301	16	52,489	962	3,307	477
1974	357	231	117	109	309	190	244	12	25,644	702	5,398	863

[1] In addition, magnesium carbonate not precipitated: 1972—17 short tons ($10,120); 1973—5 short tons ($1,436); 1974—19 short tons ($6,961).

[2] Not specifically provided for; includes magnesium silicofluoride or fluosilicate and calcined magnesia.

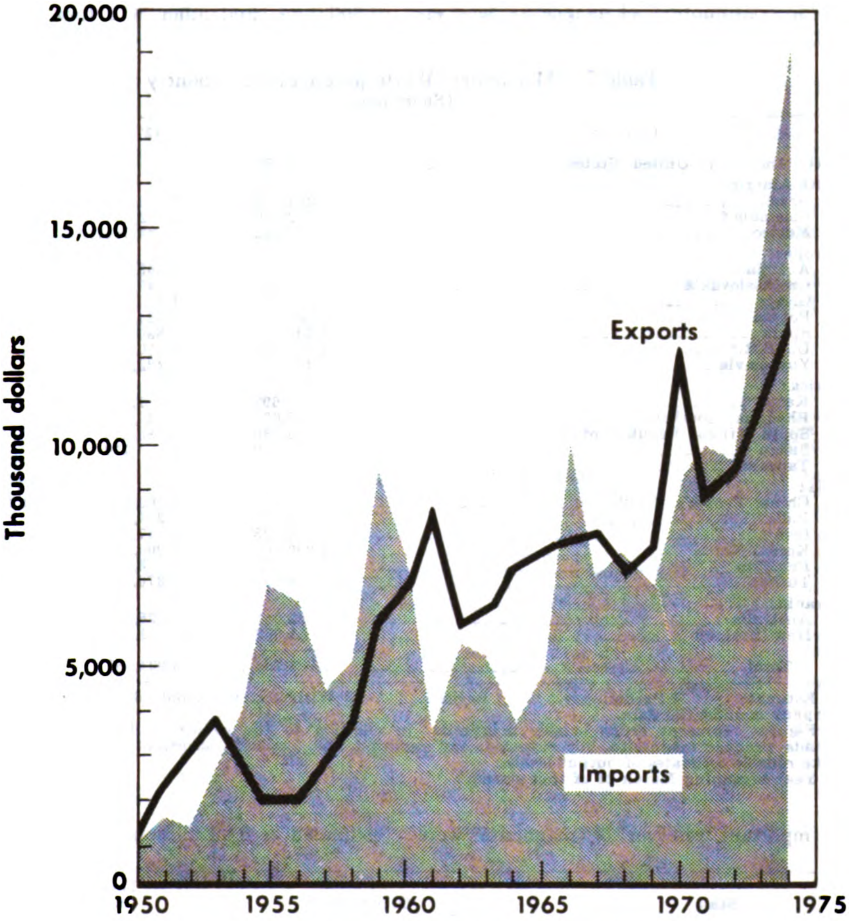

Figure 2.—Value of U.S. exports and imports of magnesia.

WORLD REVIEW

Greece.—During 1974, Financial Mining-Industrial & Shipping Corp. (FIMISCO) completed its dead-burned magnesite storage and shiploading facilities at Dafnopotamos, Mantoudi. Additionally, FIMISCO expanded its magnesite dressing plant at Paraskevorama from 100,000 tons to 250,000 tons, and doubled the output of its Moraitis facility to 70,000 tons per year. In June 1974, the Government approved plans to invest $15 million over the next 5 years in various related production facilities to boost its output of dead-burned magnesite.

Magnesite Mining Industrial and Commercial S.A. completed research and development studies to mine and process a magnesite deposit at Troupi, North Euboea. Construction at the site will begin in mid-1975, and includes an ore-dressing plant for 88,000 tons of concentrate per year and the installation of a 35,000-ton-per-year rotary kiln.

India.—Magnesite production in 1974

was 286,601 tons of which approximately 95% was from Tamil Nadu State. During 1973, consumption of magnesite was estimated as follows: Refractories, 188,100 tons; chemicals, 2,200 tons; fertilizers, 2,800 tons; and other, 450 tons.

Table 7.—Magnesite: World production by country[1]
(Short tons)

Country	1972	1973	1974 [p]
North America: United States	W	W	W
South America:			
Brazil	304,979	[e] 339,500	[e] 342,000
Colombia [e]	2,000	2,000	2,000
Mexico	22,992	31,664	[e] 32,000
Europe:			
Austria	1,575,657	1,563,768	1,603,504
Czechoslovakia	693,358	643,749	[e] 660,000
Greece	1,026,976	1,177,626	[e] 1,100,000
Poland	39,352	24,361	[e] 24,000
Spain	[r] 300,793	330,693	[e] 360,000
U.S.S.R. [e]	1,650,000	1,710,000	1,730,000
Yugoslavia	464,815	422,966	511,472
Africa:			
Kenya	692	1,672	[e] 2,200
Rhodesia, Southern [e]	22,000	22,000	22,000
South Africa, Republic of	75,830	88,393	80,103
Sudan [e]	110	110	110
Tanzania	[r] 64	120	[e] 55
Asia:			
China, People's Republic of [e]	1,100,000	1,100,000	1,100,000
India	300,938	211,644	286,601
Iran [2]	[r] 11,023	17,637	[e] 22,000
Korea, North [e]	1,900,000	1,900,000	1,900,000
Pakistan	824	3,714	[e] 2,500
Turkey	[r] 368,790	376,046	[e] 386,000
Oceania:			
Australia	[r] 22,041	25,547	[e] 27,000
New Zealand	1,058	1,278	[e] 1,300
Total	[r] 9,883,782	9,994,488	10,194,845

[e] Estimate. [p] Preliminary. [r] Revised. W Withheld to avoid disclosing individual company confidential data.

[1] Figures represent crude salable magnesite. In addition to the countries listed, Bulgaria and Canada produce magnesite, but output is not reported and available information is inadequate to make reliable estimates of output levels.

[2] Year beginning March 21 of that stated.

Important reserves of magnesite were estimated at 87.8 million tons,[3] as follows:

State	Occurrence	Tonnage (million short tons)	Grade percent
Tamil Nadu	Salem, Chalk Hills	47.7	43
Uttar Pradesh	Almora, Dewaldhar, and Agar-Girechchina	14.2	34–44
Do	Almora, Pungar Valley	13.4	NA
Do	Almora, Lahore Valley	2.8	43
Bihar	Singhbhum, Bhitardari	6.7	35
Rajasthan	Ajmer, Gaff-Sarupa	2.8	NA
Karnataka	Mysore, Dodkanya	.2	NA

NA Not available.

Israel.—During 1974, Dead Sea Works, Ltd., produced 16,500 tons of magnesium oxide and 29,700 tons of hydrochloric acid. The entire magnesium oxide output, valued at about $1 million, was exported, and the byproduct hydrochloric acid was shipped to the nearby Arad Chemical Industries, Ltd., plant to make high-grade phosphate acid. In 1975, the company planned to produce 38,500 tons of magnesia and 71,500 tons of hydrochloric acid. By 1976, the plant was expected to operate at full rated capacity (60,500 tons of magnesium oxide per year).

Norway.—Dresser Industries, Inc., and Norsk Hydro Elektrisk Kvaelstof A.S. disclosed plans to construct a $50 million seawater magnesia facility at Bodo, Norway. Construction of the plant, which will have a capacity of 220,000 tons of magnesia per year, was scheduled to begin in early 1975 and was expected to be completed by 1977.

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[3] U.S. Embassy, New Delhi, India. State Department Airgram A-206, May 31, 1974, pp. 77–79.

Peru.—The Government of Peru received $42,000 of credit from the Andean Development Corp. to study the feasibility of establishing a metallurgical and chemical complex in the Bayovar district. Based on recent mineral finds, 3,500 million tons of brines containing 162 million tons of magnesium chloride and 19 million tons of potassium chloride have been outlined in the area in addition to 38,000 million tons of phosphate material.

Turkey.—Kütahya Manyezit Isletmeleri A.S. of Ankara (Kumas) was constructing a dead-burned magnesite plant near Kütahya in west-central Turkey. The plant was designed to produce 70,000 to 80,000 tons per year of refractory-grade magnesia and was expected to be onstream in early 1976. Feed material for the plant will come from the company's magnesia operations at Kütahya and will be supplemented by high-quality magnesite from private operators in the Eskisehir area.

Seawater magnesia production facilities and capacities throughout the world by country follow:

Country	Location	Company	Capacity (short tons MgO)
Canada	Aguathuna, Newfoundland	Lundrigan's Ltd	80,000
Ireland	Dungarvan, Waterford	Pfizer Chemical Corp	75,000
Israel	Arad	Dead Sea Works, Ltd	50,000
Italy	Syracuse, Sicily	Compagnia Generale de Magnesio S.p.A	60,000
	Sant'Antioco, Sardinia	Sardamag S.p.A	120,000
Japan	Hotsu	Hokuriku Seien Kogyo K.K	72,000
	Navetsu	Nihon Kasui Kako Co	55,000
	Minamata, Onohama, Toyama	Shin-Nihon Chemical Industries Co	187,000
	Ube, Yamaguchi	Ube Chemical Industries	440,000
Mexico	Ciudad Madero, Tampico	Quimica del Mar SA	50,000
Norway	Heroya, Oslo Fjord	Norsk Hydro Elektrisk Kvaelstof A/S	80,000
People's Republic of China	Liaoning, Manchuria		10,000
U.S.S.R	NA		100,000
United Kingdom	Hartlepool County, Durham	Steetley, Ltd	250,000
United States	(1)	(1)	590,000
Total			2,169,000

[1] Seawater production facilities appear in tabulation shown in "Domestic Production" section of this chapter.

TECHNOLOGY

The domestic magnesium resource position was reviewed in a Geological Survey publication.[3] U.S. and world resources of magnesium were characterized as unlimited in brines and seawater, and large in bedrock.

An extensive review of magnesium discussed the production of metal, alloys and compounds, international trade, uses, and prices.[4] Future trends in demand and production for the metal and compounds were included.

Literature on the availability of magnesium oxide throughout the world was reviewed.[5] Production of crude magnesite was estimated to have grown from about

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[3] Bodenlos, A. J., and T. P. Thayer. Magnesian Refractories. Ch. in United States Mineral Resources. U.S. Geol. Survey Prof. Paper 820, 1973, pp. 379–384.

Hubbard, H. A., and G. E. Erickson. Limestone and Dolomite. Ch. in United States Mineral Resources. U.S. Geol. Survey Prof. Paper 820, 1973, pp. 357–364.

Smith, G. I., C. L. Jones, W. C. Culbertson, G. E. Erickson, and J. R. Dyni. Evaporites and Brines. Ch. in United States Mineral Resources. U.S. Geol. Survey Prof. Paper 820, 1973, pp. 197–216.

[4] Roskill Information Services Ltd. (London). Magnesium, Magnesite, Dolomite and Magnesium Compounds. May 15, 1973, 223 pp.

[5] Aman, Y. Magnesium Oxide Process Uses Potash Effluent as Feedstock. Chem. Age, Apr. 5, 1974, pp. 20–21.

Industrial Minerals. World Magnesia Shortage. No. 80, May 1974, pp. 23–28.

Palfreyman, M. Refractory-Grade Magnesia in Canada. Canadian Min. and Met. Bull., v. 67, No. 743, March 1974, p. 148–154.

3 million tons per year in the early 1950's to a current output of over 15 million tons per year. In the same period, production capacity of seawater magnesia expanded from about 400,000 tons per year to over 3 million tons per year.

Commercial applications have shown that the available technology for removing sulfur dioxide from stack gas is viable and reliable.[6] Processes using magnesium oxide and limestone slurry were included in the review.

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[6] Beychok, M. R. Coping With SO_2. Chem. Eng., v. 81, No. 22, Oct. 21, 1974, pp. 79–85.

Manganese

By Gilbert L. DeHuff[1]

In 1974, there was no U.S. production of manganese ore, concentrate, or nodules, containing 35% or more manganese, and 1974 was the first year since 1880 or earlier that no shipments were recorded. Imports of ferromanganese again increased above the record level of the previous year, but imports of manganese ore declined. Both consumption of ore and production of ferromanganese again dropped. The General Services Administration (GSA) continued its sales of surplus manganese stockpile items, particularly metallurgical ore and high-carbon ferromanganese. Prices for ore, alloys, and metal increased during the year under pressure of high demand; increased freight, environmental and energy costs; and inflation.

Both domestic and foreign interests, working together as a rule within different consortia, intensified their investigations of the possibilities for mining deep sea manganese nodules, but only the group headed by Deepsea Ventures Inc. included the recovery of manganese in its initial plans. Deepsea Ventures progressed to the point that it publicly announced that it was developing and evaluating, preliminary to mining, a specified area of nodule-bearing Pacific Ocean floor, claiming exclusive rights to the deposit.

Legislation and Government Programs.—Cumulative sales of stockpiled manganese items for the calendar year, as reported by GSA, were as follows in short tons (gross weight): Synthetic dioxide, 10,678; type B chemical ore, 1,000; metallurgical ore, 474,765 of stockpile grade and 23,420 of nonstockpile grade; and high-carbon ferromanganese, 233,968.

Late in December, GSA announced that it would continue to offer metallurgical-grade manganese ore for sale on a negotiated basis. Deliveries were to be limited to 750,000 short tons per fiscal year. Terms, conditions, pile numbers, locations, quantities, and analyses were contained in Solicitation of Offers ORES–233, which replaced Solicitation of Offers ORES–170 issued July 31, 1972. At the same time, 111,586 tons of type A and 63,238 tons of type B chemical-grade ore were offered for sale on a negotiated basis under Solicitation of Offers ORES–232. The type B ore was limited to an annual disposal rate of 10,000 tons, but there was no limit for type A ore. Early in October, GSA offered 118,451 tons of natual battery ore for sale on a negotiated basis under terms contained in Solicitation of Offers ORES–225. The maximum rate of disposal was placed at 15,000 tons per fiscal year.

Manganese stockpile inventory changes in calendar year 1974 consisted of the following: Synthetic dioxide decreased 6,400 short tons to 8,138 tons; type A chemical ore increased 47 tons to 146,633 tons; type B chemical ore decreased 1,174 tons to 99,497 tons; metallurgical ore, stockpile grade, decreased 1,045,896 tons to 6,203,138 tons; metallurgical ore, nonstockpile grade, decreased 9,931 tons to 1,367,951 tons; high-carbon ferromanganese dropped 449,481 tons to 662,044 tons; and electrolytic metal was down 3,957 tons to 14,196 tons.

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[1] Supervisory physical scientist, Division of Ferrous Metals.

Table 1.—Salient manganese statistics in the United States
(Short tons)

	1970	1971	1972	1973	1974
Manganese ore (35% or more Mn):					
Production (shipments)	4,737	142	578	239	--
Imports general	1,735,055	1,914,264	1,620,252	1,509,793	1,225,033
Consumption	2,363,937	2,155,454	2,331,459	2,140,058	1,880,176
Manganiferous ore (5% to 35% Mn):					
Production (shipments)	368,302	198,334	147,161	203,055	272,908
Ferromanganese:					
Production	835,463	759,896	800,723	683,075	544,361
Exports	21,747	4,526	6,842	8,574	7,011
Imports for consumption	290,946	242,778	348,539	r 390,591	421,222
Consumption	1,000,611	899,011	967,968	1,116,602	1,115,395

r Revised.

DOMESTIC PRODUCTION

There was neither production nor shipment of manganese ore, concentrate, or nodules, containing 35% or more manganese, in the United States in 1974. This was the first year since at least 1880 that no shipments of manganese ore were recorded.

Ferruginous manganese ore containing 10% to 35% manganese was produced and shipped in New Mexico, and shipments continued from mine or mill stockpiles on the Cuyuna Range of Minnesota. As in 1973, total shipments of ferruginous manganese ores or concentrates were greater than those of the preceding year. Manganiferous iron ore containing 5% to 10% manganese was neither produced nor shipped in either 1974 or 1973. Manganiferous zinc residuum continued to be recovered from New Jersey zinc ores.

Table 2.—Manganese and manganiferous ore shipped [1] in the United States, by State
(Short tons)

Type and State	1973		1974	
	Gross weight	Manganese content	Gross weight	Manganese content
Manganese ore (35% or more Mn, natural):				
Montana	239	125	--	--
Total	239	125	--	--
Manganiferous ore:				
Ferruginous manganese ore (10% to 35% Mn, natural):				
Minnesota	170,971	21,526	225,560	28,744
New Mexico	32,084	4,171	47,348	6,060
Total [2]	203,055	25,697	272,908	34,804
Value manganese and maganiferous ore	$1,531,390	--	$2,323,254	--

[1] Shipments are used as the measure of manganese production for compiling U.S. mineral production value. They are taken at the point at which the material is considered to be in marketable form for the consumer. Besides direct-shipping ore, they include, without duplication, concentrate and nodules made from domestic ores.

[2] There were no shipments of manganiferous iron ore containing 5% to 10% Mn, natural.

CONSUMPTION, USES, AND STOCKS

In the production of raw steel (ingots, continuous- or pressure-cast blooms, billets, slabs, etc., and including steel castings), consumption of manganese as ferroalloys, metal, and direct-charged ore was 13.3 pounds per short ton of raw steel produced. Of this total, 11.5 pounds was ferromanganese; 1.4 pounds, silicomanganese; 0.05 pound, spiegeleisen; 0.25 pound, manganese metal; and 0.1 pound manganese ore (containing 35% or more manganese). The comparable 1973 total, on the same basis, was 12.9 pounds with ferromanganese at 11.1, silicomanganese at 1.3, spiegeleisen at 0.05, metal at 0.25, and ore at 0.2. In addition to the aforementioned consumption of manganese in 1974, there was consumed per short ton of raw steel produced approximately 1.2 pounds of manganese contained in manganese ore used in making pig iron or equivalent hot metal. The comparable figures for 1973 and 1972 were 1.1 and 1.2 pounds, respectively.

Large capital expenditures for pollution control programs to meet environmental standards continued to be reported by the producers of manganese ferroalloys and metal. High energy, labor, and material costs encountered by the industry were further increased by the significant added costs of operation of the pollution-control equipment. Energy shortage problems continued to be experienced. In August, the Rockwood, Tenn., plant of the Roane Electric Furnace Division of Woodward Corp. was purchased by Engelhard Minerals & Chemicals Corp. Marketing of the products will be by the latter's Philipp Brothers Division. Operations of Tenn-Tex Alloy Corp. of Houston after July 1 were under a 6-year lease to Union Carbide Corp., with all production going to the latter.

Table 3.—Consumption and industry stocks of manganese ore[1] in the United States

(Short tons)

	Consumption		Stocks Dec. 31, 1974
	1973	1974	
By use:			
Manganese alloys and metal	1,684,127	1,415,563	1,279,267
Pig iron and steel	237,807	222,449	226,196
Dry cells, chemicals and miscellaneous	218,124	242,164	335,168
Total	2,140,058	1,880,176	1,840,631
By origin:			
Domestic	35,961	69,749	61,434
Foreign	2,104,097	1,810,427	1,779,197
Total	2,140,058	1,880,176	1,840,631

[1] Containing 35% or more manganese (natural).

Table 4.—Consumption, by end use, and industry stocks of manganese ferroalloys and metal in the United States in 1974

(Short tons, gross weight)

End use	Ferromanganese		Silicomanganese	Spiegeleisen	Manganese metal[1]
	High carbon	Medium and low carbon			
Steel:					
Carbon	737,043	110,533	100,750	9,829	8,157
Stainless and heat resisting	7,198	7,779	12,643	4	6,323
Full alloy	89,799	25,479	34,504	952	1,391
High-strength low-alloy	96,572	9,915	8,639	--	1,308
Electric	458	284	960	--	31
Tool	1,759	360	16	--	643
Cast irons	16,660	2,573	10,677	7,893	115
Superalloys	439	60	90	--	318
Alloys (excludes alloy steels and superalloys)	5,049	1,470	3,645	39	15,072
Miscellaneous and unspecified	759	1,206	5,242	--	1,390
Total	955,736	159,659	177,166	18,717	34,748
Stocks, December 31	270,809	53,801	60,609	3,082	6,019

[1] Virtually all electrolytic.

Electrolytic Manganese Metal.—All of the manganese metal produced domestically was electrolytic, and it is certain that virtually all of that imported was electrolytic metal. Virtually all of the metal consumed was electrolytic metal, but it is probable that some low-carbon ferromanganese and some manganese-aluminum additives were erroneously reported by consumers as manganese metal. The metal used to make manganese-aluminum additives is included in table 4 under the "Alloys (excludes alloy steels and superalloys)" category. The additives are not knowingly included in the table, it being desired to obtain consumption at the metal rather than the additive level of the usage cycle. Production of electrolytic metal in 1974 was 27,033 short tons, compared with 26,175 tons in 1973, and was by the same three plants of the same three companies: Foote Mineral Co., New Johnsonville, Tenn.; Kerr-McGee Chemical Corp., Hamilton (Aberdeen), Miss.; and Union Carbide Corp., Marietta, Ohio. Kerr-McGee Corp. was increasing its annual capacity from 8,200 to 9,300 tons with completion scheduled for 1975. After completion of a tender offer in September, Newmont Mining Corp. announced that it had increased its ownership of Foote Mineral Co. to 84% of Foote's outstanding voting shares.

Ferromanganese.—The Johnstown, Pa., plant of Bethlehem Steel Corp. was the only producer of ferromanganese in blast furnaces in 1974. Electric furnaces were used to produce ferromanganese by six other companies in seven plants: Airco Alloys Div., Airco Inc., Calvert City, Ky.; Ohio Ferro-Alloys Corp., Philo, Ohio; Roane Electric Furnace Div. of Woodward Corp., Rockwood, Tenn. (plant acquired by Engelhard Minerals & Chemicals Corp. in August 1974 and operated afterwards as Roane Electric Furnace Co.); Tenn-Tex Alloy Corp. of Houston, Houston, Tex.; and Union Carbide Corp., Alloy, W. Va., Marietta, Ohio, and Portland, Oreg. Fused salt electrolysis continued to be the method used by the Chemicals unit of Diamond Shamrock Corp., Kingwood, W. Va., to make low-carbon ferromanganese sold under the trade name of Massive Manganese. The company planned to double Kingwood's capacity to 17,000 short tons per year by the end of 1975. Cost was estimated to be between $5 million and $6 million, of which more than $1 million will be for pollution-control equipment. U.S. shipments of ferromanganese from furnaces totaled 574,000 short tons compared with 779,000 tons in 1973.

The production reported in the various tables of this chapter is net production; that is, the quantity of ferromanganese produced for shipment outside the producing establishment. It does not include the remelt—fines, offgrade, or other ferromanganese output of the furnace—that was fed back to the furnace or lost in the plant, and which is included in gross production figures reported by the furnace operator.

Table 5.—Ferromanganese and silicomanganese produced in the United States and manganese ore[1] consumed in their manufacture

Year	Production				Manganese ore[1] consumed (gross weight, short tons)			
	Ferromanganese							
	Gross weight (short tons)	Manganese content		Silicomanganese (gross weight short tons)	Foreign[2]	Domestic[2]	Per ton of ferromanganese made[3]	Per ton of ferromanganese and silicomanganese made[3][4]
		Percent	Short tons					
1970 ---	835,463	78.5	655,436	193,000	2,098,210	1,216	2.4	2.0
1971 ---	759,896	78.6	597,205	165,000	1,820,408	7,033	2.4	1.9
1972 ---	800,723	78.3	627,358	153,000	1,896,483	25,620	2.3	2.0
1973 ---	683,075	78.8	538,119	184,000	1,648,806	25,912	2.4	1.9
1974 ---	544,361	78.0	424,405	196,000	1,348,425	55,822	2.5	1.8

[1] Containing 35% or more manganese (natural).
[2] Includes ore used in producing silicomanganese and metal.
[3] Includes ore used in producing silicomanganese.
[4] Ratio of ore consumed to ferromanganese produced if silicomanganese is considered a special grade of ferromanganese.

Table 6.—Manganese ore used in producing ferromanganese, silicomanganese, and manganese metal in the United States in 1974, by source of ore

Source	Gross weight (short tons)	Mn content, natural (percent)
Domestic [1]	55,822	52
Foreign:		
Africa	407,777	48
Australia	121,150	50
Brazil	454,050	48
Cuba [1]	26,036	48
India	129,362	46
Mexico	56,572	39
U.S.S.R.[1]	38,961	50
Unidentified	114,517	--
Total	1,404,247	48

[1] Most, if not all, from U.S. Government surplus stockpile disposals.

Silicomanganese.—Production of silicomanganese in the United States increased to 196,000 short tons from the 184,000 tons of the previous year. This is net production produced for shipment, and does not include silicomanganese produced for use as an intermediate in the same plant for the production of medium- or low-carbon ferromanganese. Silicomanganese shipments from furnaces were 192,000 tons, compared with 196,000 tons in 1973. In 1974, seven companies used eight plants to produce silicomanganese for shipment: Airco Alloys Div., Airco Inc., Theodore (Mobile), Ala.; Interlake Inc., Beverly, Ohio; Ohio Ferro-Alloys Corp., Philo, Ohio; Roane Electric Furnace Div. of Woodward Corp., Rockwood, Tenn. (plant acquired by Engelhard Minerals & Chemicals Corp. in August and operated afterwards as Roane Electric Furnace Co.); Tenn-Tex Alloy Corp. of Houston, Houston, Tex.; and Union Carbide Corp., Alloy, W. Va., Marietta, Ohio, and Portland, Oreg. End-use consumption of silicomanganese, that is consumption outside the ferroalloy plants, was 15.9% that of ferromanganese, compared with 14.2% in 1973. The increases in this ratio of the last 2 years, a reversal of the declining trend evidenced since 1965, may be attributed in large part to an acute shortage of ferrosilicon ordinarily used for silicon additions.

Spiegeleisen.—The New Jersey Zinc Co. continued to produce spiegeleisen in electric furnaces at Palmerton, Pa.

Pig Iron.—A total of 465,000 short tons of manganese-bearing ores containing over 5% manganese (natural) was consumed in the production of pig iron (or its equivalent hot metal). Domestic sources supplied 256,000 tons, of which 171,000 tons was manganiferous iron ore containing 5% to 10% manganese, and 85,000 tons was ferruginous manganese ore containing 10% to 35% manganese. Foreign sources supplied 209,000 tons, of which 1,000 tons was manganiferous iron ore, and 208,000 tons was manganese ore containing 35% or more manganese.

Battery and Miscellaneous Industries.—The ore reported in table 3 includes that consumed in making synthetic manganese dioxide by either electrolytic or chemical means, but it does not include consumption of the synthetic dioxide. Although some synthetic dioxide is used for chemical purposes, most of it is used in the manufacture of dry-cell batteries, particularly for the manganese-alkaline type, premium or heavy-duty Leclanché (manganese dioxide-ammonium chloride-zinc) cells, and as a blend with natural ore in ordinary Leclanché cells.

The domestic ore and much of the foreign ore used for chemical and miscellaneous purposes did not meet national stockpile specification P–81–R for chemical-grade ore.

Kerr-McGee Corp. was engaged in increasing the annual capacity of its Henderson, Nev., plant from 8,700 to 12,000 short tons of electrolytic synthetic manganese dioxide; completion was scheduled for 1975.

PRICES

Strong world demand, increased freight, environmental, and energy costs, and inflation, all contributed to increases in manganese prices in 1974.

Manganese Ore.—All manganese ore prices are negotiated, dependent in part on the characteristics and quantity of ore offered, delivery terms, and fluctuating ocean freight rates. Trade journal quotations reflect the paper's evaluation of the market. American Metal Market quotations for metallurgical-grade manganese ore began the year at 80 to 93 cents, nominal, per long-ton unit, c.i.f. eastern seaboard and Gulf ports, for a manganese content of 46% to 48%; $1.00 to $1.10, nominal, same basis, for a content of 48% to 50% manganese. In July these quotes were increased to 80 to 95 cents, nominal, and $1.05 to $1.15, nominal, respectively. Metals Week's quotation for the higher grade ore was $1.05 to $1.15 for the first half of the year, and $1.10 to $1.18 until early December when it was increased to $1.18 to $1.38. At mid-month it was marked up to $1.38 to $1.42 per long ton unit, c.i.f. U.S. ports, and identified as the producer agent and dealer price for metallurgical ore of low impurity, minimum 47% to 48% manganese. This quote was continued to the end of the month.

Manganese Alloys.—The price of most domestically produced standard high-carbon ferromanganese having a manganese content of 78% was $200 per long ton, f.o.b. producer plant or shipping point, until Government price controls were removed in March. However, during at least part of this period, some domestic production sold for $250 per long ton. Upon removal of the controls, which had been instituted in 1973, the price became $270 per long ton. Three subsequent increases found the price at $400 per long ton at the beginning of November. By that time, the Metals Week quotation for imported alloy of the same grade had reached $450 to $460 per long ton of alloy, having been $190 to $197 at the beginning of the year. The quotes for the imported material were unchanged for the balance of 1974, but the producer price was increased to $440 on December 27.

Manganese Metal.—The price of standard or comparable grades of electrolytic manganese metal increased several times during the year, going from a dual price of 33.25 to 37.25 cents per pound that was effective January 1 to a price of 54 cents per pound effective November 18 through the end of the year. These prices continued to be f.o.b. producer plant for shipments of 30,000 pounds or more.

FOREIGN TRADE

Exports of ferromanganese were 7,011 short tons valued at $2,203,957, compared with 8,574 tons valued at $2,136,917 in 1973. Of the 1974 quantity, Canada took 3,638 tons; Taiwan, 1,178 tons; Sweden, 416 tons; the Netherlands and West Germany, each 414 tons; the Dominican Republic, 244 tons; Mexico, 224 tons; Venezuela, 184 tons; Colombia, 112 tons; Brazil and the Republic of South Africa, each 44 tons; Guatemala, 40 tons; France, 25 tons; and five other countries, smaller quantities. Exports classified as "manganese and manganese alloys, wrought or unwrought, and waste and scrap" totaled 2,318 tons valued at $2,118,803, compared with 4,660 tons valued at $3,108,688 in 1973. This classification includes electrolytic manganese metal and manganese-copper alloys, but it does not include ferromanganese. Exports of ore and concentrate containing more than 10% manganese totaled 223,088 tons valued at $13,656,462, compared with 57,448 tons valued at $4,535,463 in 1973. Of the total, large quantities having relatively low average values were distributed as follows: Spain, 62,000 tons; Canada, 57,000 tons; Mexico, 29,000 tons; the Netherlands, 21,000 tons; and Norway, 19,000 tons. For the most part, these tonnages appear to have been metallurgical ore obtained from GSA sales of Government surplus stocks.

The average grade of imported manganese ore in 1974 was 48% manganese, as in 1973. Brazil supplied 38% of this ore in 1974; Gabon, 25%; and Australia, 19%. Imports of manganiferous ore (more than 10% but less than 35% manganese) totaled 1,717 short tons, of which 1,653 tons came from Morocco and 64 tons came from Mexico. The tonnages from each country had an average manganese content of 34%.

Ferromanganese imports for consumption again exceeded the record high of the previous year. France and the Republic of South Africa continued to be the principal suppliers. Both are countries in which a U.S. company has a substantial interest in a ferromanganese produced. Silicomanganese imports for consumption totaled 67,751 short tons containing 44,720 tons of manganese. Sources and tonnages (gross weight) were as follows: Norway, 23,666; Japan, 18,616; Spain, 8,205; Yugoslavia, 5,622; the Republic of South Africa, 3,102; Brazil, 2,480; the Netherlands, 1,654; Sweden, 1,644; the Republic of Korea, 1,378; Canada, 992; West Germany, 392. Imports for consumption classified as unwrought manganese metal, except alloys, and metal waste and scrap, totaled 2,506 short tons, compared with 2,452 tons in 1973 and 4,121 tons in 1972. Of the 1974 total, 2,123 tons came from the Republic of South Africa, 209 tons from Japan, and 174 tons from Canada. A small quantity (40 pounds) of high unit value ($7.45) came from West Germany.

Table 7.—U.S. imports [1] of manganese ore (35% or more Mn), by country

Country	1973			1974		
	Gross weight (short tons)	Mn content (short tons)	Value (thousands)	Gross weight (short tons)	Mn content (short tons)	Value (thousands)
Australia	123,813	61,458	$2,760	233,454	114,038	$8,136
Brazil	629,833	299,402	15,767	463,763	222,000	15,105
Canada	611	354	51	--	--	--
Gabon	393,037	196,114	10,007	302,530	150,117	12,712
Ghana	38,965	18,601	1,076	9,850	4,531	425
Mexico	105,019	41,206	2,616	39,021	16,431	1,018
Morocco	26,427	13,923	1,343	51,210	27,506	3,081
South Africa, Republic of	119,038	55,920	2,002	73,602	32,909	3,222
Zaire	73,050	35,657	1,781	51,603	25,291	1,392
Total	1,509,793	722,635	37,403	1,225,033	592,818	45,091

[1] Quantities for general imports and imports for consumption were identical.

Table 8.—U.S. imports for consumption of ferromanganese, by country

Country	1973			1974		
	Gross weight (short tons)	Mn content (short tons)	Value (thousands)	Gross weight (short tons)	Mn content (short tons)	Value (thousands)
Belgium-Luxembourg	--	--	--	1,615	1,270	$608
Brazil	4,858	3,720	$660	1,598	1,230	258
Canada	1,382	1,098	410	10,397	7,987	2,844
France	137,712	106,314	17,803	212,439	164,898	42,340
Germany, West	218	185	96	2,420	1,949	976
India	47,242	35,591	5,160	15,000	11,239	3,053
Italy	--	--	--	1,103	911	334
Japan	24,264	19,430	5,027	29,107	22,501	9,257
Norway	[r] 26,272	[r] 20,543	[r] 3,590	9,498	7,431	2,191
Portugal	--	--	--	552	434	180
South Africa, Republic of	138,897	109,143	18,200	127,106	99,716	23,098
Spain	5,435	4,367	1,260	8,290	6,740	2,698
Sweden	4,311	3,494	1,131	1,932	1,445	542
Taiwan	--	--	--	165	123	52
Total	[r] 390,591	[r] 303,885	[r] 53,337	421,222	327,874	88,426

[r] Revised.

Imports for consumption classified as "manganese compounds, other" totaled 3,086 short tons, compared with 4,355 tons in 1973 and 7,937 tons in 1972. The sources, gross weights, and values per pound in 1974 were as follows: Japan, 2,194 tons (28 cents); Belgium, 713 tons (28 cents); the United Kingdom, 145 tons (14 cents); West Germany, 29 tons (71 cents); the Republic of South Africa, 5 tons (34 cents); and the Netherlands, less than 1 ton ($3.61). The imports from Japan and Belgium appear to have consisted largely, if not entirely, of synthetic manganese dioxide. Imports of manganese sulfate were 20 tons in 1974, 40 tons in 1973, 42 tons in 1972, and 22 tons in 1971. Except for 2½ tons from West Germany in 1972 and in 1971, all of these sulfate imports came from Belgium.

Tariffs.—The duty on manganese ore from most nations remained suspended, while the statutory rate continued to be 1 cent per pound of contained manganese and continued to apply to ore from the U.S.S.R. and the People's Republic of China. The respective rates of duty for metal and the principal manganese ferroalloys continued as shown in the following tabulation:

Material	TSUS No.	Rate of Duty	
		Most Favored Nation	Statutory
Metal	632.32	1.5¢/lb + 10% ad valorem [1]	1.875¢/lb + 15% ad valorem [1]
Ferromanganese:			
High carbon	607.37	0.3¢/lb Mn	1.875¢/lb Mn
Medium carbon	607.36	0.46¢/lb Mn	1.875¢/lb Mn
Low carbon	607.35	0.3¢/lb Mn + 2% ad valorem	1.875¢/lb Mn + 15% ad valorem
Silicomanganese	607.57	0.46¢/lb Mn + 3.5% ad valorem	1.875¢/lb Mn + 15% ad valorem

[1] Duty on metal waste and scrap temporarily suspended through June 30, 1975.

WORLD REVIEW

Of the numerous organizations working toward the mining of manganese nodules from the ocean floor, only the consortium headed by Deepsea Ventures, Inc., included manganese recovery in its initial exploitation plans. All others were focusing their attention on recovery of only the contained nickel, copper, and cobalt for the start of operations.

In May, Tenneco Inc., the parent company of Deepsea Ventures, announced that it had signed an agreement with three Japanese trading firms—Nichimen Co., Ltd., C. Itoh & Co., Ltd., and Kanematsu-Gosho Ltd., all of Tokyo—that was expected to lead to a joint venture to assess a selected Pacific deep sea deposit, test the mining and processing systems, and test the market for the manganese, nickel, copper, and cobalt products to be recovered. The Japanese group later organized as Japan Manganese Nodule Development Co. and included minor participation by two other firms: Hitachi Shipbuilding and Engineering Co.; and Japan Metals and Chemicals Co.[2] Projected development and evaluation will involve $20 million over a period of up to 3 years. Total expenditures are expected to reach approximately $200 million before commercial production can be achieved by Deepsea Ventures, the operating company.

In November or earlier, United States Steel Corp. through its wholly-owned subsidiary, Essex Iron Co.; and the Belgian mining firm, Union Minière, S.A., through its wholly-owned Maryland subsidiary, Union Mines Inc., joined the venture by acquiring options to buy equity interests. If all outstanding options are exercised, these two companies and the Japanese group will each have equal participation of 23.75%. The remaining 28.75% will be held by the present owners—now 90% Tenneco and 10% individual U.S. citizens. Deepsea Ventures, in a November 14 letter addressed to the Secretary of State, gave public notice that it had discovered, taken possession of, and was engaged in developing and evaluating, preliminary to mining, a seabed deposit of manganese nodules lying in the North Pacific between longitudes 124°20'W and 127°46'W, and between latitudes 14°16'N and 15°44'N, at depths between 7,500 and 16,000 feet. This rectangular area is a bit more than a third of the distance between Hawaii and Colombia, and approximately 1,500 miles south of San Francisco.

Exclusive rights to the deposit were claimed in the belief that such claim was valid under existing international law. Deepsea further requested diplomatic protection and protection of its investment. Initial plans called for recovering approximately 1.5 million wet short tons of nodules per year from the deposit, from which approximately 280,000 short tons of high-purity manganese metal, 12,500 tons of nickel, 10,000 tons of copper, and 2,370 tons of cobalt were expected to be recovered. Possible later expansion of operations to an annual recovery rate of approximately 4.4 million wet short tons per year of nodules would be dependent on market conditions.[3]

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[2] American Metal Market. V. 81, No. 225, Nov. 19, 1974, p. 18.

[3] Congressional Record. Dec. 5, 1974, pp. E6970–E6971.

Early in the year, Kennecott Copper Corp. announced a 5-year, $50 million research and development program having for its objective the commercial recovery of approximately 3 million dry tons of nodules per year from the Pacific Ocean floor, possibly by 1980–81. Kennecott, with a 50% interest, will manage the program. Rio Tinto-Zinc Corp. Ltd., London, has a 20% interest. Consolidated Gold Fields Ltd., London; Mitsubishi Corp., Tokyo; and Noranda Mines Ltd., Toronto, each have a 10% interest. As with Deepsea Ventures in its activities, it has been estimated that Kennecott has already spent approximately $20 million over a 10-year period.

Costs for a 3-million-ton-per-year nodule-processing plant in the United States to recover nickel, copper, and cobalt supplied by two mining units with a total design capacity of 4 million tons of nodules per year were estimated by British members of the Kennecott consortium. Total investment was estimated to range from a low of $350 million to a high of $650 million; annual operating costs including depreciation, from a low of $115 million to a high of $170 million. It was doubted that commercial production could begin before 1980. Admitting the difficulty of predicting metal prices for that year, and recognizing taxation uncertainties, it was nevertheless concluded that nodule operations appeared to be competitive with potential nickel laterite deposits, with increasing energy costs favoring the nodule operations. It was further concluded that great profitability (implied by some proponents in the past) of first-generation plants was unlikely; that taxation and royalties should be no more than for land-based mining operations; and that accelerated depreciation or some other form of tax relief might be necessary in the early years. Political and legal problems remained the greatest uncertainty facing any commercial operation.[4]

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[4] Moncrieff, A. G., and K. B. Smale-Adams. The Economics of First Generation Manganese Nodule Operations. Min. Cong. J., v. 60, No. 12, pp. 46–52.

Table 9.—Manganese ore: World production by country

(Short tons)

Country [1]	Percent Mn [e]	1972	1973	1974 [p]
North America:				
Mexico [2]	35+	325,867	401,268	444,379
United States (shipments)	52	578	239	--
South America:				
Argentina	27–30	[r] 15,751	13,876	[e] 14,300
Bolivia [2] [3]	28+	103	709	565
Brazil	38–50	2,268,000	[e] 2,378,000	[e] 2,000,000
Chile	41–47	17,731	15,911	31,631
Colombia	NA	542	NA	NA
Peru	27–33	[r] 10,019	8,574	[e] 8,800
Europe:				
Bulgaria	30–	38,000	[r] [e] 42,000	[e] 44,000
Greece	50	5,848	6,859	[e] 7,100
Hungary	30–	[r] 170,000	150,000	155,000
Italy	30–	28,260	28,074	15,441
Portugal	37–40	5,895	206	78
Spain	30	14,519	13,643	[e] 13,200
U.S.S.R.[4]	35	8,619,000	9,088,000	[e] 9,400,000
Yugoslavia	30+	16,909	10,712	14,641
Africa:				
Angola	30+	41,557	5,161	(5)
Botswana	30+	758	375	9
Egypt	NA	2,655	2,961	5,453
Gabon	50–53	2,134,800	2,115,105	2,356,719
Ghana	32–50+	549,324	350,768	[e] 330,000
Morocco	53	105,896	161,102	192,662
South Africa, Republic of	30+	3,606,205	4,602,839	4,128,576
Zaire	35–55	407,283	368,131	340,366
Asia:				
Burma	NA	308	308	[e] 310
China People's Republic of [e]	30+	1,100,000	1,100,000	1,100,000
India [6]	10–54	1,810,000	1,692,000	1,595,000
Indonesia	47+	8,309	17,731	15,227
Iran [7]	33+	[e] 5,500	24,200	[e] 19,800
Japan	27–45	287,424	208,113	183,621
Korea, Republic of (South)	40	2,204	1,897	2,328

See footnotes at end of table.

Table 9.—Manganese ore: World production by country—Continued

(Short tons)

Country [1]	Percent Mn [e]	1972	1973	1974 [p]
Asia—Continued:				
Pakistan	35 —	140	190	130
Philippines	52	2,746	4,379	945
Thailand	46–50	21,883	40,034	31,930
Turkey	35 +	[r] 13,482	2,815	3,770
Oceania:				
Australia	37–53	[r] 1,283,885	1,678,164	1,677,704
New Hebrides	42–44	31,137	33,215	[8] 41,758
Total	NA	[r] 22,947,518	24,567,559	24,175,438

[e] Estimate. [p] Preliminary. [r] Revised. NA Not available.

[1] In addition to the countries listed, Cuba and the Territory of South-West Africa also may have produced manganese ore and/or manganiferous ore but available information is inadequate to make reliable estimates of output levels. Low grade ore not included in this table has been reported as follows in short tons: Czechoslovakia (about 17% Mn): 1972—nil; 1973—1,100; 1974—1,100; Malaysia (grade unspecified but apparently a manganiferous ferruginous ore): 1972—nil; 1973—31,246; 1974—93,985; Romania (about 22% Mn): 1972—143,000; 1973—155,000; 1974—155,000; Republic of South Africa (15–30% Mn in addition to material listed in table): 1972—112,058; 1973—73,333; 1974—98,769.

[2] Estimated on the basis of reported contained manganese.

[3] Exports.

[4] Source: The National Economy of the U.S.S.R., Central Statistical Administration, Moscow. Grade represents the annual average obtained from reported metal contents for the gross weights shown in the table.

[5] Official publications list no production during first 3 months of 1974. Information for subsequent months is not available but owing to internal political problems, it is likely that production, if any, was quite modest.

[6] Of total 1972 output, 57.6% graded below 35% Mn and of total 1973 output, 64% graded below 35% Mn, with the balance in each year grading 35% Mn to 48% Mn or more. Comparable 1974 production breakdown not available, but export figures for April to October of that year give 78% below 35% Mn.

[7] Iranian calendar year beginning March 21 of year stated.

[8] Japanese imports from New Hebrides.

Argentina.—Manganese ore produced in 1973 had an average manganese content of 28%. Imports of manganese ore and concentrates were 62,000 short tons in 1973, compared with 46,000 in 1972. Production of rhodochrosite, mined as a semiprecious stone rather than an ore, was 131 tons in 1973 and 149 tons in 1972; exports were 98 and 128 tons in 1973 and 1972, respectively.

Australia.—The deposit of manganese ore at Groote Eylandt, Northern Territory, has been proved over an area of 20 square miles, and reserves have been estimated by the operating company, Groote Eylandt Mining Co. Ltd., to be on the order of 300 million tons with an average grade of roughly 48% manganese. This tabular deposit is of lower Cretaceous age, flat lying or gently dipping, and basically pisolitic or lateritic in character with evidence of weathering and redeposition. It is from 1.5 to 50 feet thick, although the portions being mined in 1974 were approximately 10 to 13 feet in thickness. The ore, which grades up to 55% manganese, is essentially of two types: "Pisolitic ore" averaging about 44% manganese in the ground, and "massive ore" averaging about 48% to 50%. Comparatively unconsolidated silts and sands, and in a few areas a manganiferous ferruginous laterite, cover the deposit. Similar unconsolidated sands, silts, clays, claystones, and soft sandstones underlie it. In 1974, almost all the ore was beneficiated; the stripping ratio was approximately one overburden to two ore. Some selective mining was practiced. Beneficiation consisted of crushing, screening, scrubbing to remove a contaminant coating, heavy-media separation of the coarser fractions, and jigging to upgrade the fines. Seven major products were prepared:

Product	Percent						
	Mn	Fe	SiO_2	Al_2O_3	P	K_2O	BaO
Premium coarse (chemical-grade)	52.5	2.0	2.9	2.9	0.090	1.00	3.00
Metallurgical lump	48.8	3.3	5.8	3.5	.090	2.50	.50
Siliceous lump	43.0	4.5	13.0	3.6	.070	2.70	.35
High-grade intermediates	43.0	6.5	8.5	6.0	.075	2.00	.72
Low-grade intermediates	39.0	6.9	12.0	7.0	.075	2.00	.60
Premium-grade fines	53.0	2.0	3.0	3.0	.090	0.80	2.30
Low-grade fines	37.0	11.5	12.5	5.8	.080	1.45	.35

Sulfur analyses, all 0.007 or 0.008; CaO, 0.10 or less; and Na_2O, 0.20 or less. Groote Eylandt shipments in 1973 were approximately 1.5 million short tons, bringing total shipments since the commencement of operations to more than 5.5 million tons. Expansion plans, if consummated, will result in a capacity sufficient to provide for annual sales of 2.2 million short tons of ore in 1976, with possible later expansion to 3 million tons as market and other conditions permit.[5] Strikes closed the mine during almost all of November.

Broken Hill Proprietary Co. Ltd., parent company of both Groote Eylandt Mining Co. Ltd. and Tasmanian Electro Metallurgical Co. Pty. Ltd. (TEMCO), announced that planned expansion of the latter's Bell Bay, Tasmania, plant would include a 24-megavolt-ampere furnace for production of ferromanganese or silicomanganese, a machine for sintering manganese ore, and the necessary modifications to power facilities, all of which were scheduled to be completed by the end of 1975. Groote Eylandt was to supply manganese ore; coke and coal were to come from Australia's eastern States; and regular tonnages of wood chips were to come from local sources. Bell Bay currently uses two electric furnaces to produce ferromanganese and silicomanganese: one rated at 13 megavolt-amperes, the other at 16 megavolt-amperes.[6]

Bolivia.—Exports of manganese ore, in terms of manganese content, were 170 short tons in 1974, 213 tons in 1973, and 30 tons in 1972. Exports for 1972 were reportedly by Grupo Minero Aral; those of 1973 and 1974 were identified only as "medium mines." Argentina was the recipient in 1974 and presumably was in 1973 and 1972, also.

The manganese ore bed at Mutún Mountain reportedly was undeveloped. Although feasibility studies for Mutún will be concerned primarily with development of its iron ores and its projected iron and steel complex, one study is planned to include exploration of the manganese horizon halfway up this mountain at its northernmost point where reserves have been estimated to amount to 500,000 tons of unstated grade. All activity at Mutún is by Empresa Siderúrgica Boliviana S.A. (SIDERSA), the Government's iron and steel enterprise.

Botswana.—The manganese ore produced in 1973 was unbeneficiated ore exported to the Republic of South Africa for treatment.

Brazil.—Amapá manganese ore shipments in 1973 by Indústria e Comércio de Minerios, S.A. (ICOMI) totaled 1,400,000 short tons, compared with 1,219,000 tons in 1972. The 1973 shipments were loaded out of the port of Santana in 68 vessel cargoes, with those for export going to 15 countries besides the United States: Argentina, Belgium, Czechoslovakia, Canada, England, France, Germany, Greece, the Netherlands, Italy, Japan, Mexico, Norway, Spain, and Yugoslavia.[7] The only Brazilian customer in 1974 was the ferromanganese producer, Eletrosiderurgica Brasileira, S.A. (SIBRA), in Bahia State, with deliveries made by coastal steamer at a freight rate of approximately $30 per ton, compared with a rate to the U.S. east coast of approximately $7 per ton. Total Brazilian consumption of manganese ore was estimated to be approximately 300,000 to 400,000 tons per year, most of which was trucked or railed to the consumer from mines in Minas Gerais and Goiás. The Urucum mine in Mato Grosso, in which United States Steel Corp. formerly had a large interest, ceased operations in 1972.[8] In 1973, production of manganese ore by the Meridional mine in Minas Gerais was 93,000 short tons having a manganese content of 37.4%; partial additional output from other mines in the State, as reported by the Central Railroad, was 39,000 tons. Three firms contributed to Brazil's production of 80,000 tons of high-carbon ferromanganese in 1974. SIBRA with 38,000 tons was the principal producer. One firm, Prometal Produtos Mètalurgicos, S.A. (PROMETAL), produced 4,900 tons of medium- and low-carbon ferromanganese; four firms produced 38,000 tons of silicomanganese.

Bulgaria.—Preliminary designs have been completed for developing the Dobrudzha manganese deposits, which have been under study for more than 4 years. An agreement was reported to have been reached between the Government and Kaiser Industries for cooperation in the development of manganese mining.[9]

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[5] Lonie, W. M., and J. L. McIntosh. Occurrence and Development of Sedimentary Manganese Ore, Groote Eylandt, Northern Australia. Pres. at Circum-Pacific Energy and Mineral Resources Conf., Honolulu, Hawaii, Aug. 30, 1974, 13 pp.

[6] Mining Journal (London). V. 282, No. 7729, Mar. 8, 1974, pp. 171–173.

[7] Skillings Mining Review. V. 63, No. 5, Feb. 2, 1974, p. 21.

[8] Yolen, S. Brazil's Big Exporter Sees Strong '75 Market. Am. Metal Market, v. 82, No. 18, Jan. 24, 1975, p. 2A.

Canada.—Metallurgical-grade manganese ore was consumed in 1973 to produce manganese ferroalloys by Chromium Mining & Smelting Corp., Ltd., Beauharnois, Quebec, and by Union Carbide Canada Limited, Beauharnois, Quebec. In addition, approximately 2,000 tons of battery-grade ore was used by producers of dry cells. Preliminary data show imports of manganese ore, in terms of manganese content, to have totaled 146,000 short tons in 1973, compared with 98,000 tons in 1972. The sources were as follows (1972 figures in parentheses): The United States, 48,000 tons (7,000); Gabon, 39,000 (30,000); Brazil, 26,000 (33,000); Zaire, 16,000 (14,000); the Republic of South Africa, 13,000 (zero); the U.S.S.R., 4,000 (3,000); Mexico, 415 (113); other, 3 (10,000). Ferromanganese imports totaled 27,000 tons, gross weight, in 1973, compared with 19,000 tons in 1972, distributed as follows: The United States, 12,000 tons (3,000); France, 6,000 (3,000); Norway, 5,000 (zero); the Republic of South Africa, 4,000 (12,000); Japan, 70 (47); other, zero (274). Silicomanganese imports were 11,000 tons, gross weight, in 1973 and 17,000 in 1972, with the following sources: The United States, 7,000 (8,000); Norway, 1,000 (7,000); the Republic of South Africa, 1,000 (zero); Yugoslavia, 1,000 (356); the Republic of Korea, zero (907). Exports of ferromanganese were 3,000 tons, gross weight, in 1973 and 2,000 tons in 1972, with almost all going to the United States in both years.[10]

Chile.—The manganese ore produced in 1973 had an average manganese content of 41.6%.

China, People's Republic of.—Manganese ore production in China remains largely a little known activity. An excerpt from the Hunan Provincial Service, September 27, 1973, stated that 35 small mines were opened in the 4 years previous in Ningyuan County of Hunan Province with production of 358,000 tons.[11]

France.—Production of blast furnace ferromanganese and spiegeleisen in 1974 totaled 588,000 short tons.

Gabon.—Negotiations with the Japanese firm, Okura-Trading, for construction of a ferromanganese plant advanced to the point where a company was contemplated with Government participation of 10% in addition to that of Cie. Minière de l'Ogooúe (COMILOG) and United States, French, Swedish, Italian, and Japanese firms. The plant could possibly be in operation by 1980.[12] COMILOG exported 2,103,000 short tons of metallurgical-grade ore and 54,000 tons of battery/chemical-grade ore in 1973.[13] Shipments of manganese ore in 1974 were 2.3 million tons. Production of battery- and chemical-grade ore in 1974 was 77,000 tons. Early in the year, the Gabon Government announced that it was purchasing a 10% equity in COMILOG. Later, a contract was signed with a European consortium for construction of that part of the Transgabon Railroad that will run from the port of Owendo, near Libreville, to Franceville, with completion expected in 1980 at a cost of approximately $400 million. This should permit a material increase in production of manganese ore by COMILOG after that time. Equity of United States Steel Corp. in COMILOG, formerly 49%, has been reduced to 44%.

Greece.—Concentrates produced in 1974 had a manganese content of 49% to 50%. Exports of pyrolusite from Greece in 1973 totaled 8,300 short tons, of which 4,200 tons went to West Germany and 3,900 tons went to France. Tekkosha Co. Ltd. and Mitsubishi Corporation started construction in March of their previously reported joint venture synthetic (electrolytic) manganese dioxide plant in the Thessaloniki Industrial Zone.

Iran.—Manganese ore produced in 1973 had an average manganese content of 40% to 44%.

Italy.—Production of manganese ore in 1973 was from the Gambatese mine where exploration of recent years for new ore was reported to have been unsuccessful. Imports of manganese ore in 1973 totaled

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[9] Metals Week. V. 45. No. 6, Feb. 11. 1974. p. 6.

[10] Boucher, M. A. Manganese—1973. Mineral Development Sector, Department of Energy, Mines and Resources, Ottawa, Canada. December 1974, 7 pp.

[11] Mining Annual Review—1974 (London). June 1974, p. 403.

[12] U.S. Joint Publications Research Service. Translations on Africa, No. 1566. JPRS64143. Feb. 21, 1975, p. 11.

[13] Mining Journal (London). V. 282, No. 7231, Mar. 22, 1974, p. 206.

311,000 short tons, most of which came from the Republic of South Africa (176,000 tons), Gabon (101,000 tons), and Brazil (19,000 tons). Imports in 1972 totaled 300,000 tons. The manganese ore produced in 1974, as in 1973, was reported to have an average manganese content of 27%.

Japan.—Imports of manganese ore[14] in 1974 were approximately 2 million short tons with more than one-third of the total coming from each of Australia and the Republic of South Africa, more than 10% from Gabon, and lesser quantities from the U.S.S.R., Romania, India, Thailand, Malaysia, China, New Hebrides, Mexico, and Brazil. With ferromanganese having the lowest power requirement of the ferroalloys Japan produces for export, 2,000 kilowatt-hours per metric ton, and with power costs having doubled in the year to more than 7 yen (2.4 cents) per kilowatt-hour, it was expected that ferroalloy exports in the 1975 fiscal year (beginning April 1) might well be limited almost entirely to ferromanganese with the low-carbon grade being in the best competitive position. Japan Metals and Chemicals obtained some of its power from its own geothermal plant at a cost of 2.5 yen (0.9 cents) per kilowatt-hour. Expansion planned should provide sufficient power to provide all of the company's requirements from this source within the next 10 years.[15] In 1974, production of ferromanganese was 688,000 short tons; that of silicomanganese was 494,000 tons; electrolytic manganese metal, 9,545 tons; synthetic manganese dioxide, 49,374 tons. The manganese ore produced in the year had an average manganese content of 26.8%.

The Ministry of International Trade and Industry (MITI) was planning an economic stockpile that would include manganese among its inventories in a quantity expected to be approximately 10% of annual consumption.

Morocco.—The manganese ore produced in 1974 was chemical-grade ore or concentrate with an average manganese dioxide content of 84%. Virtually all came from the Imini mine, which has proven reserves of 1.65 million short tons, plus another possible 0.5 to 1 million tons, in a 12-mile-long seam running due west of the Ouarzazate-Marrakech road. Exploration for other deposits was being conducted to the east of the road. This underground mine operated as a joint venture of the Moroccan state mining monopoly, Bureau de Recherches et de Participations Minières (BRPM), and the French firm, Soc. Anonyme Chérifienne d'Etudes Minières (SACEM). The United States was the largest customer for its output, with most of the remainder going to western Europe.

New Hebrides.—Manganese ore produced in 1973 had an average manganese content of 42%.

Pakistan.—The ore produced in 1973, and probably earlier recent years, contained less than 35% manganese.

South Africa, Republic of.—Production of the various grades of metallurgical ore in 1973 was as follows, in short tons: 30% to 40% manganese, 2,898,000; 40% to 45%, 272,000; 45% to 48%, 307,000; and over 48%, 1,031,000. Local sales were, respectively, 625,000, 14,000, 56,000, 206,000 tons. Of the chemical ore produced, 87,000 tons contained 35% to 65% manganese dioxide, and 9,000 tons contained 65% to 75% manganese dioxide. Local sales were 90,000 and 7,400 tons, respectively. Production of ferruginous manganese ores, containing 15% to 30% manganese and 20% to 35% iron, totaled 73,000 tons. Exports were 185,000 tons; there were no local sales. Total exports of metallurgical ore were 3,868,000 tons. Only 350 tons of chemical ore was exported. Delta Manganese (Pty) Ltd. was in commercial production of electrolytic manganese metal by the middle of the year at its new plant at Nelspruit, Transvaal, with initial output going to Europe and Canada. Expansion was underway at the ferromanganese plant of Ferroalloys Ltd., in Natal.

Thailand.—Battery-grade (75% manganese dioxide) production in 1974 was 9,800 short tons. In 1973 it totaled 12,500 tons, of which 5,000 tons came from Lamphun Province, and 2,200 tons from Phrae Province, both in the Northern Region; and 3,900 tons were from Loei Province in the Eastern Region. The remainder came from four other provinces in the Northern Region and two in the Central Region. Songkhla Province in the Southern Region and Rayong in the Central Region each produced 9,900 tons of metallurgical ore in that year; Lamphun, Chiang Mai, and Phetchabun provinces in the Northern Region produced 3,400, 1,700 and 1,200 tons, respectively. Lesser quantities came from one other province in each of the Southern, Central, and Northern regions. Domestic consumption of battery-grade ore in 1973 was 5,700 tons, and no metallurgical ore was consumed. Exports of battery-grade ore totaled 3,900 tons, of which 2,200 tons went to Taiwan, 1,500 tons to Hong Kong, and 160 tons to Japan. Exports of metallurgical ore were 1,200 tons, all of which went to Taiwan except for less than 100 tons, which went to Hong Kong. In the 9 previous years, Japan and Hong Kong took most of the battery-grade ore that was exported, whereas Japan and Taiwan took most of the metallurgical ore, with Japan getting by far the larger part.

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[14] The term "manganese ore" as used in this particular instance may include some lower grade manganiferous ores.

[15] Saito, F. Japan Sees Drop in Ferroalloy Exports. Am. Metal Market, v. 82, No. 99, May 21, 1975, pp. 25-26.

Zaire.—In November 1973, Société Minière de Kisenge (SMK) was nationalized with management unchanged and production continuing to be marketed by Beceka-Manganese, former owner of most of the company's shares. Mining was from three open pits at Kisenge in the southern part of Shaba (formerly Katanga) Province. SMK in 1973 exported 298,000 short tons of manganese oxide ore containing 48% to 55% manganese and 11,000 tons of carbonate ore averaging 35% manganese. Mining of the carbonate ore started in May 1973.

TECHNOLOGY

The basic oxygen furnace (BOF) steelmaking process has encountered problems resulting from the use of hot metal having a low manganese content due to the use of low-manganese iron ore pellets. In an effort to alleviate these problems, the Bureau of Mines studied the effects on pellet production of additions of manganiferous iron ores and of various manganese compounds. Additions of either manganese dioxide or manganiferous iron ores generally improved compression strength of the pellets with a corresponding loss of reducibility. Indications were that little modification of existing techniques and processes would be required, and the advantages of lower induration temperatures could possibly pay for part of the manganese cost. The high-silica manganiferous ores from Minnesota's Cuyuna Range had the disadvantage of increasing the silica content of the pellets. The study concluded that the addition of manganese to iron pellets was feasible, but that some penalties in smelting could be expected.[16]

A study by a group of steel-company and other metallurgists defined the principal uses of manganese in steelmaking: (1) To reduce hot shortness by forming manganese sulfide instead of ferrous sulfide; (2) to prevent carbide precipitation at grain boundaries; (3) to increase strength by solid solution hardening; (4) to increase toughness at high strength levels and low temperatures; (5) to increase hardenability; and (6) as a substitute for part of the nickel in austenitic stainless steels.[17] Desulfurization of hot metal before it reaches the BOF is a growing practice in spite of the fact that the cost of using calcium carbide or magnesium for external desulfurization is 3 times the cost of using manganese and fluorspar. The use of external desulfurization might eventually reach 80% or more of production, with some companies probably attaining 100%. Substitution of zirconium, titanium, or rare-earth elements, all of limited availability and relatively high cost, can only be used for killed steels, and the resulting flat-rolled killed steels have the undesirable feature of being relatively soft. Manganese will continue to be required for production of rimmed, capped, and semikilled steels. Manganese has no satisfactory substitutes for its alloying effects and for inhibiting carbide formation at grain boundaries. The general consensus of all those participating in the 1-day workshop associated with the study was that, although not essential for countering the harmful effects of sulfur, steel cannot be made in quantity without manganese; there is in reality no substitute for it.

Experimental work at the University of Illinois, Urbana, Ill., demonstrated that sawdust impregnated with an active form of manganese dioxide had considerably better efficiency and capacity for adsorption of hydrogen sulfide than did all activated carbons with which it was compared. Granulated activated carbon has been the most commonly used solid filter material for removing hydrogen sulfide from the air. Manganese dioxide impregnated sawdust has the disadvantage that it will ignite if allowed to dry out completely with exposure to temperatures of more than 100° C. Its efficiency was at a maximum at a relative humidity of 80%, whereas both it and the activated carbons were inefficient at relative humidities of less than 20%.[18]

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[16] Schluter, R. B., and B. W. Carriere. Influence of Manganese Additions Upon Properties of Iron Ore Pellets. BuMines RI 7870, 1974, 17 pp.

[17] National Materials Advisory Board, National Research Council-National Academy of Sciences–National Academy of Engineering. A Semi-Delphi Exercise on Fluorspar and Manganese in Steelmaking. NMAB–317, 1974, 58 pp.

Further pursuit of the previously reported Trans-Atlantic Geotraverse (TAG) project of the National Oceanic and Atmospheric Administration (NOAA), U.S. Department of Commerce, confirmed the existence of hydrothermal manganese oxide deposits on the east wall of the median rift valley of the Mid-Atlantic Ridge. The deposits, estimated to cover 40 square miles, were reported to be of higher manganese content than the average for seafloor nodules but very poor in iron, nickel, cobalt, and copper. They were estimated to have a much more rapid growth rate than the nodules, to be still in the process of accumulation, and to occur where plate tectonic theory would expect them to be. Two volcanic peaks on the valley floor showed evidence of recent eruption. It is hoped to explore the deposit by drilling.[19]

Continuing, but as yet uncompleted, studies under the auspices of NOAA of the possible environmental effects of deep sea mining of manganese nodules have suggested that neither the beneficial nor the harmful effects of mining and lifting to surface will be significant. It has been contended that redistribution of sediments by turbidity currents and other natural phenomena are greater "by many orders of magnitude on a world-wide scale." However, the processing and extractive metallurgy of manganese nodules at sea, and the discharge of resulting waste materials, could be matters for serious concern unless adequate precautions are taken. It was noted that, at least for first-generation plants, economies would appear to dictate that the nodules be processed at an onshore facility.[20] An independent South African report, in addition to assessing all other aspects of the recovery possibilities for the ocean-floor manganese nodules, supported the foregoing discussion of environmental effects.[21]

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[18] Hudson, J. L., E. H. Johnson, D. F. S. Natusch, and R. L. Solomon. Hydrogen Sulfide Adsorption by Manganese Dioxide and Activated Carbon. Environmental Sci. & Technol., v. 8, No. 3, March 1974, pp. 238–243.

[19] American Metal Market. V. 81, No. 70, Apr. 10, 1974, p. 8.

[20] Congressional Record. Nov. 19, 1974, p. E6685.

Roels, O.A., et al. The Environmental Impact of Deep-Sea Mining, Progress Report. Nat. Oceanic and Atmospheric Admin. Tech. Rept. ERL 290-OD 11, May 1973, 185 pp.

[21] Granville, A. Prospects for the Recovery of Minerals From the Sea. Nat. Inst. Met. Rept. No. 1644, Johannesburg, Republic of South Africa, June 20, 1974, 38 pp.

Mercury

By V. Anthony Cammarota, Jr.[1]

Primary mercury production of 2,189 flasks,[2] valued at $616,619, was from 12 mines in California, Nevada, Alaska, and New York in 1974. During the year, only about six mines could be classified as consistent producers.

New Idria Mining & Chemical Co. put the town of Idria and the New Idria mercury mine in San Benito County, Calif., on the auction block, but there were no buyers. About 150 families had moved out in late 1973. In Nevada, Placer Amex Inc. announced plans to open the McDermitt mine, a 20,000-flask-per-year facility, at a cost of $9.7 million.

Secondary production of 8,293 flasks was down from the 1973 level. This includes 2,353 flasks sold by the General Services Administration (GSA).

The consumption of 59,479 flasks was 10% higher than that of 1973, although in the second half of 1974 consumption declined. The largest increases were noted for catalysts and electrolytic preparation of chlorine and caustic soda, with agriculture showing the largest decline.

General imports of 52,102 flasks were 13% higher than those of 1973; the United States continued to rely on foreign sources for almost all of its primary mercury demand. The major suppliers were Canada, Mexico, and Algeria. The U.S. rate of duty on primary mercury remained at $9.50 per flask. Exports were 466 flasks.

World production of mercury was 262,286 flasks, a 2% drop from that of 1973. Most countries produced mercury near 1973 levels. In Italy, the Government took over control of the mercury mines which had been showing losses over the past several years, and Japan's only mercury mine closed.

Representatives from Algeria, Italy, Mexico, Spain, Turkey, and Yugoslavia agreed to establish a floor price of $350 per flask. Following the meeting, New York prices advanced to the floor price, a gain of almost 20% within 6 weeks. By yearend, prices had retreated to the $150 level. The average New York price for the year was $281.69 per flask.

The Environmental Protection Agency (EPA) promulgated final effluent limitations for mercury-cell chlor-alkali plants and began public hearings on the use of mercury biocides.

Legislation and Government Programs.—Government financial assistance on a participatory basis was available for mercury exploration projects through the Office of Minerals Exploration, U.S. Geological Survey, to the extent of 75% of the acceptable costs. No contracts were executed during 1974.

GSA continued its sale of surplus mercury on a sealed-bid basis at the rate of 500 flasks per month. Sales totaled 2,353 flasks, with prices ranging from $277 per flask in February to $323 per flask in June. At yearend 2,275 flasks remained available for disposal.

No action was taken by Congress on authorizing the release of the total surplus of 157,405 flasks of mercury from the strategic stockpile. As of December 31, 1974, total strategic stockpile accumulations from all programs stood at 200,062 flasks.

Final effluent limitation guidelines for existing and new sources in the inorganic chemicals manufacturing category were promulgated by EPA. For mercury-cell plants, the daily effluent limitation is 0.00028 pound of mercury per 1,000 pounds of product for existing sources, and 0.00014 pound of mercury per 1,000 pounds of product for new sources.[3] EPA proposed an amendment to the emission standards for hazardous air pollutants which would limit mercury emissions from the incineration and drying of waste water treatment plant sludges to a maximum of 3,200 grams per day.[4] In addition, the National Institute for Occupational Safety and Health submitted criteria for a recommended limit of 0.05 milligram of mercury per cubic meter on the occupational exposure to inorganic mercury.[5]

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[1] Physical scientist, Division of Nonferrous Metals.

[2] Flask as used throughout this chapter refers to the 76-pound flask.

The Commissioner of Food and Drugs proposed to establish an action level for mercury in fish and shellfish of 0.5 part per million.[6] This level gave a tenfold margin of safety to the vast majority of the U.S. population.

EPA opened hearings in October on the cancellation of biocidal uses of mercury, including mildewcides in paint. The hearings were recessed until February 1975 when witnesses for the registrants were scheduled to appear.

Table 1.—Salient mercury statistics

	1970	1971	1972	1973	1974
United States:					
Producing mines	79	56	37	24	12
Production flasks	27,296	17,883	r 7,849	r 2,227	2,189
Value thousands	$11,130	$5,229	r $1,604	r $637	$617
Exports flasks	4,653	7,232	400	342	466
Reexports do	50	--	563	--	--
Imports:					
For consumption do	21,972	28,449	28,834	46,026	52,180
General do	21,672	29,750	29,179	46,076	52,102
Stocks, Dec. 31 do	16,554	16,862	15,708	17,946	19,877
Consumption do	61,503	52,257	52,907	54,283	59,479
Price: New York, average per flask	$407.77	$292.41	$218.28	$286.23	$281.69
World:					
Production flasks	284,014	300,634	r 278,968	r 268,265	262,286
Price: London, average per flask	$411.45	$282.46	$203.01	$273.54	$267.94

r Revised.

DOMESTIC PRODUCTION

Production of 2,189 flasks came from 12 mines in 1974, down from 24 in 1973. Many of the very small operations closed in 1974. A significant portion of the production, as byproduct mercury, came from a zinc smelter. Some exploration and development work was conducted by several small operations. Of the total production, 91% came from producers of over 100 flasks. Principal mines (properties producing 100 to 499 flasks) in 1974 were as follows:

State	County	Mine
Alaska	Kuskokwim River Region.	White Mountain.
California	Marin	Chileno Valley.
Do	Napa	Manhatten-One Shot.
Do	do	Oat Hill.
Do	Santa Clara	Guadalupe.
Do	do	New Almaden.
Nevada	Pershing	Red Bird.

California provided 60% of the total mercury production, up from 55% in 1973. The Red Bird mine was responsible for most of Nevada's production. In addition, the Carlin Gold Mining Co. continued to recover mercury as a byproduct at its gold mine in Eureka County. The White Mountain mine in Alaska shipped most of its cinnabar concentrate to Oregon for retorting, but exported the equivalent of about 54 flasks to the Orient.

Placer Amex Inc. began construction of a new flotation concentrator, and a furnace and condenser system at its open pit mine near the site of the old Cordero mine in Humboldt County, Nev. Reserves were estimated at 3 million tons of ore averaging 10 pounds of mercury per ton, about 15% to 25% of which is in the chloride mineral corderoite. The mill was designed to process about 100 tons of ore per day to produce a 60% concentrate feed for a Herreshoff furnace. The offgases were to be scrubbed and refrigerated to remove mercury and meet EPA mercury emission standards. Startup was expected in May 1975.

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[3] Federal Register. Inorganic Chemicals Manufacturing Point Source Category. V. 39, No. 49, Mar. 12, 1974, pp. 9612–9623.

[4] Federal Register. Asbestos and Mercury—Proposed Amendments to National Emission Standards. V. 39, No. 208, Oct. 25, 1974, pp. 38063–38073.

[5] Federal Register. Occupational Exposure to Inorganic Mercury. V. 39, No. 13, Jan. 18, 1974, pp. 2271–2274.

[6] Federal Register. Action Level for Mercury in Fish and Shellfish. V. 39, No. 236, Dec. 6, 1974, pp. 42738–42740.

The average grade of all ore processed in 1974, including ore treated in concentrators, decreased to 4.4 pounds of mercury per ton. Because of the insufficiency of reported data in 1974, the amount of ore treated and ore grade were based to a large extent on knowledge of producing areas and their historical data.

Secondary production of mercury fell to 8,293 flasks, from 10,329 flasks in 1973. Most of the decline represented inventory depletion of secondary mercury from a mercury-cell plant closed several years ago. Dental amalgams, scrap batteries, various types of sludges, mercury from a dismantled chlor-alkali plant, and discarded mercury-containing instruments were the major sources of secondary mercury.

Table 2.—Mercury produced in the United States, by State

Year and State	Producing mines [1]	Flasks	Value [2] (thousands)
1973			
California	18	1,219	$349
Nevada	3	[r] [3] 722	[r] 207
Alaska, Oregon, Texas	3	[r] [4] 286	[r] 81
Total	24	[r] 2,227	[r] 637
1974			
Alaska	1	[5] 124	35
California	9	1,311	370
Nevada and New York	2	754	212
Total	12	2,189	617

[r] Revised.
[1] Mercury mines only.
[2] Value calculated at average New York price.
[3] Includes 24 flasks of mercury estimated to be contained in cinnabar concentrate for export.
[4] Includes 32 flasks of mercury estimated to be contained in Alaskan cinnabar concentrate for export.
[5] Includes 54 flasks of mercury estimated to be contained in cinnabar concentrate for export.

Table 3.—Mercury ore treated and mercury produced in the United States [1]

Year	Ore treated (short tons)	Mercury produced	
		Flasks	Pounds per ton of ore
1970	424,510	26,795	4.8
1971	265,790	17,444	5.0
1972	82,580	[2] 7,004	6.5
1973 [r]	26,257	[2] 2,101	6.1
1974	28,858	[2] 1,680	4.4

[r] Revised.
[1] Excludes mercury produced from old surface ores, dumps, placers, and as a byproduct.
[2] Includes mercury contained in concentrate for export.

Table 4.—Production of secondary mercury in the United States

(Flasks)

Year	Industrial production	GSA releases	Total
1970	7,348	703	8,051
1971	10,899	5,767	16,666
1972	12,139	512	12,651
1973	7,746	2,583	10,329
1974	5,940	2,353	8,293

CONSUMPTION AND USES

Consumption continued to climb for the third consecutive year, to 59,479 flasks. The largest gains were noted for catalysts (93%) and electrolytic preparation of chlorine and caustic soda (29%). Mercury compounds as catalysts found increased use in polyurethane formation, in which the mercury catalyst is mixed with the formulation and becomes part of the urethane structure. Agricultural use declined 46%, reflecting EPA's ban on many agricultural and industrial mercury biocides. The use of mercury in antifouling paint was not evident after the first quarter of 1974. The major uses for mercury were electrical apparatus, 33%; electrolytic preparation of chlorine and caustic soda, 28%; mildew-proofing paint, 11%; and industrial and control instruments, 10%.

Chlorine production increased by 6% to an estimated 10.9 million short tons, but only 24.8% of the total was produced in mercury cells, up slightly from 24.6% in 1973. Consumption of mercury per ton of chlorine produced increased to 0.48 pound, from 0.39 pound in 1973. The increase came about because the changeover in some plants from graphite to dimensionally stable anodes required a higher operating level of mercury in the cells.

Table 5.—Mercury consumed in the United States, by use
(Flasks)

Use	1970	1971	1972	1973	1974
Agriculture [1]	1,811	1,477	1,836	1,830	980
Amalgamation	219	--	--	--	--
Catalysts	2,238	1,012	800	673	1,298
Dental preparations	2,286	2,361	2,983	2,679	3,024
Electrical apparatus	15,952	16,885	15,553	18,000	19,678
Electrolytic preparation of chlorine and caustic soda	15,011	12,154	11,519	13,070	16,897
General laboratory use	1,806	1,798	594	658	476
Industrial and control instruments	4,832	4,871	6,541	7,155	6,202
Paint:					
Antifouling	198	414	32	32	6
Mildew-proofing	10,149	8,191	8,190	7,571	6,807
Paper and pulp manufacture	226	2	1	--	--
Pharmaceuticals	690	682	578	606	597
Other [2]	5,858	2,407	4,258	1,913	2,452
Total known uses	61,276	52,254	52,885	54,187	58,417
Total unknown uses	227	3	22	96	1,062
Grand total	61,503	52,257	52,907	54,283	59,479

[1] Includes fungicides and bactericides for industrial purposes.
[2] Includes mercury used for installation and expansion of chlorine and caustic soda plants.

Table 6.—Mercury consumed in the United States in 1974
(Flasks)

	Primary	Redistilled	Secondary	Total
Agriculture [1]	974	--	6	980
Catalysts	1,199	--	99	1,298
Dental preparations	276	1,714	1,034	3,024
Electrical apparatus	12,516	6,627	535	19,678
Electrolytic preparation of chlorine and caustic soda	15,475	--	1,422	16,897
General laboratory use	227	216	33	476
Industrial and control instruments	1,874	3,168	1,160	6,202
Paint:				
Antifouling	6	--	--	6
Mildew-proofing	6,805	--	2	6,807
Pharmaceuticals	148	449	--	597
Other [2]	2,110	337	5	2,452
Total known uses	41,610	12,511	4,296	58,417
Total unknown uses	3	719	340	1,062
Grand total	41,613	13,230	4,636	59,479

[1] Includes fungicides and bactericides for industrial purposes.
[2] Includes mercury used for installation and expansion of chlorine and caustic soda plants.

Table 7.—Stocks of mercury, December 31
(Flasks)

Year	Producer	Consumer and dealer	Total
1970	3,861	12,693	16,554
1971	5,373	11,489	16,862
1972	4,171	11,537	15,708
1973	3,927	14,019	17,946
1974	4,100	15,777	19,877

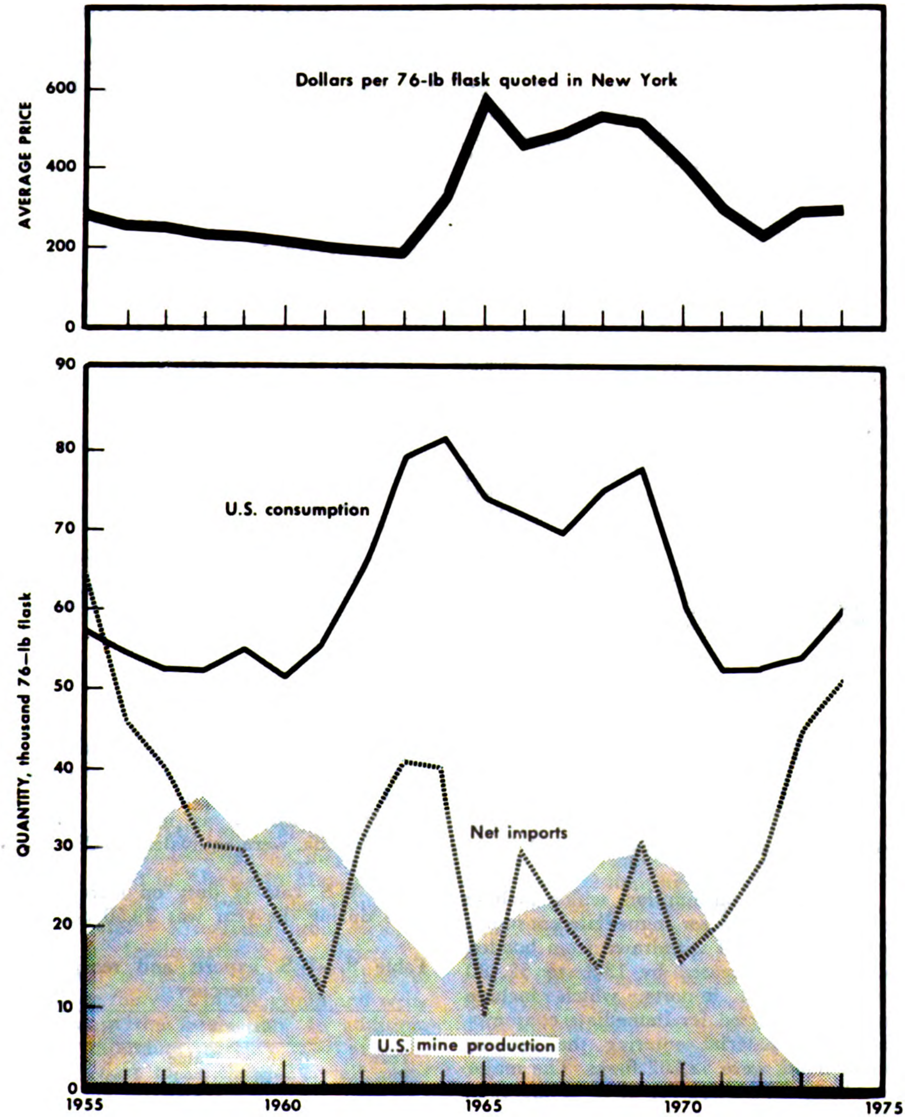

Figure 1.—Trends in production, consumption, and price of mercury.

PRICES

Mercury prices exhibited their characteristic volatility during the year. New York prices were stable in the $270 to $295 per flask range for the first 5 months of the year. After the May meeting of mercury producers in Algeria, at which a floor price of $350 per flask was set, the price climbed to that level within several weeks.

From July through December prices fell almost continuously, finishing the year at $190 to $225 per flask. Reasons cited for the precipitous drop in prices were the influx of substantial amounts of mercury from the U.S.S.R., People's Republic of China, and Turkey, traders selling surplus metal at a loss, low demand, some producers selling below the floor price, and the imminent opening of the McDermitt mine in Nevada. The average New York price was $281.69 per flask in 1974.

London prices followed the New York pattern, although usually they were lower by about $15 to $30 per flask. By late December the price had fallen to $150 to $175 per flask.

Table 8.—Average monthly prices of mercury at New York and London
(Per flask)

Month	1973		1974	
	New York [1]	London [2]	New York [1]	London [2]
January	$282.50	$260.72	$275.45	$266.72
February	304.78	289.38	284.22	269.50
March	314.36	303.94	288.27	270.25
April	290.71	283.00	282.32	267.95
May	266.64	257.75	294.32	274.44
June	250.75	243.72	335.00	315.63
July	275.24	263.44	317.50	304.45
August	292.96	274.82	289.09	274.73
September	276.05	266.18	279.15	272.19
October	294.67	270.66	265.36	259.56
November	299.25	286.61	254.94	245.50
December	287.00	282.29	214.52	194.39
Average	286.23	273.54	281.69	267.94

[1] Metals Week, New York.
[2] Metal Bulletin, London; reported in terms of U.S. dollars.

FOREIGN TRADE

Mercury exports increased to 466 flasks from 342 flasks in 1973. The major recipients were Canada, the Republic of Korea, and Venezuela. In addition, cinnabar concentrate containing about 54 flasks was exported.

Imports for consumption, which include mercury imported for immediate consumption plus material withdrawn from bonded warehouses, increased by 13% to 52,180 flasks. General imports, which include mercury imported for immediate consumption plus material entering the country under bond, were 52,102 flasks. The major suppliers, accounting for 85% of the total imports, were Canada (33%), Mexico (20%), Algeria (20%), and Spain (12%). Included in the import figures are 506 flasks entering the country as secondary metal from Canada, Mexico, and the United Kingdom. Imports of mercury compounds, mainly as mercury cyanide from Canada, were equivalent to 286 flasks of metal.

The U.S. rate of duty on mercury imports during the year was $9.50 per flask.

Table 9.—U.S. exports and reexports of mercury

Year	Exports		Reexports	
	Flasks	Value (thousands)	Flasks	Value (thousands)
1972	400	$129	563	$121
1973	342	170	--	--
1974	466	270	--	--

Table 10.—U.S. imports for consumption[1] of mercury, by country

Country	1972		1973		1974	
	Flasks	Value (thousands)	Flasks	Value (thousands)	Flasks	Value (thousands)
Algeria	3,007	[r] $745	11,876	$3,135	10,449	$2,843
Belgium-Luxembourg	--	--	5	6	--	--
Canada	13,803	2,686	17,440	4,748	16,972	4,592
China, People's Republic of	--	--	99	29	--	--
Denmark	--	--	50	13	--	--
Finland	--	--	--	--	15	5
Germany, West	--	--	100	27	500	142
Hungary	100	17	--	--	--	--
Italy	--	--	1,005	260	845	212
Japan	2	(2)	--	--	45	13
Mexico	5,529	941	2,775	710	10,597	2,830
Netherlands	53	24	300	84	--	--
Norway	[3]1,329	305	--	--	--	--
Peru	1,461	310	626	153	1,276	333
Philippines	100	23	50	15	100	26
Spain	1,829	438	7,286	1,834	6,293	1,624
Sweden	7	17	7	13	--	--
Switzerland	14	22	6	10	4	7
Taiwan	--	--	40	12	--	--
Turkey	450	102	700	174	353	96
United Kingdom	53	13	13	5	486	67
Yugoslavia	1,097	238	3,648	923	4,245	1,158
Total	28,834	[r] 5,881	46,026	12,151	52,180	18,948

[r] Revised.

[1] General imports in 1972 were 29.179 flasks ([r] $5.903.190). Peru 2.210 flasks ($458.495). Yugoslavia 1,402 flasks ($298.345). Spain 1.120 flasks ($254.677). In 1973. 46.076 flasks ($12.164.010). Yugoslavia 3.698 flasks ($935.973). In 1974. 52.102 flasks ($13.858,283). Italy 705 flasks ($178.675). Yugoslavia 4.307 flasks ($1.174.480).

[2] Less than ½ unit.

[3] Reclaimed metal.

WORLD REVIEW

World mercury production decreased to 262,286 flasks from 268,265 flasks in 1973. Italy, Mexico, Spain, and Yugoslavia accounted for 47% of the total. Representatives of Algeria, Italy, Mexico, Spain, Turkey, and Yugoslavia, the major world producers, met in Algeria in May. Canada attended as an observer. The group decided to create a mercury producer's organization, headquartered in Algiers. A provisional secretariat was established to coordinate the work of the group and write the rules of the association. In addition, it set a minimum mercury sales price of $350 per flask to be charged by all members of the group.

The Organization for Economic Cooperation and Development (OECD), whose 24 member countries include most of the industrialized market-economy nations of the world, including the United States, recommended that more attention be paid to limiting mercury emissions from mining and mineral-refining operations and coal burning, and also that mercury toxicity in humans be investigated. OECD asked its member countries to supply it with national consumption data and amounts of mercury discharged from chlor-alkali plants.

Table 11.—Mercury: World production by country
(Flasks)

Country	1972	1973	1974 [p]
Algeria	13,361	13,300	[e] 13,300
Australia	17	16	[e] 15
Canada	[r] 14,637	12,500	14,000
Chile	640	798	[e] 800
China, People's Republic of [e]	26,000	26,000	26,000
Colombia	153	144	[e] 150
Czechoslovakia	6,614	6,991	[e] 7,100
Finland	212	196	[e] 4,930
Germany, West	2,900	4,700	[e] 200
Ireland	1,250	1,345	[e] 1,360
Italy	41,801	32,692	[e] 24,950
Japan	[r] 5,019	3,742	1,409
Mexico	22,510	[1] 21,640	[e] 21,200
Peru	[r] 4,550	3,581	[e] 3,800
Philippines	3,341	2,160	[e] 2,300
Spain	53,994	60,076	[e] 60,200
Tunisia	238	112	[e] 145
Turkey	7,963	8,439	[e] 8,400
U.S.S.R. [e]	50,000	52,000	54,000
United States	[r] 7,349	2,227	2,189
Yugoslavia	16,419	15,606	15,838
Total	278,968	268,265	262,286

[e] Estimate. [p] Preliminary. [r] Revised.
[1] Exports.

The First International Mercury Congress was held in Barcelona, Spain, in May.[7] The meeting focused on geology and extractive metallurgy although biological effects of mercury received much attention. World cumulative demand for mercury was forecast at 10.5 million flasks based on a growth rate of 2.2% from 1974 to 2000. World reserves were considered sufficient to meet the demand. The level of world consumption in 1973 was given at about 245,000 flasks. Byproduct mercury from base metal refining was discussed as an increasingly important source of supply.

Canada.—Cominco, Ltd., produced 14,000 flasks, 12% more than in 1973. Ore production at its Pinchi Lake mine amounted to 173,000 tons, compared with 163,000 tons in 1973. Assuming that all the ore mined was treated to produce metal, the ore grade increased from 5.8 pounds of mercury per ton in 1973 to 6.2 pounds in 1974. Ore reserves at yearend were reported by Cominco to be 1,300,000 tons containing 110,000 flasks of mercury. The company reported that it has experienced no health problems at Pinchi Lake in the 6 years of operation.

Italy.—Italy's nonferrous metals agency, Ente Gestione Aziende Minerali Metallurgiche, (EGAM) acquired Monte Amiata Societa Minerario per Azioni and Stabilimento Minerario del Siele early in the year. An EGAM subsidiary will be responsible for the mercury operations through a new company, Societa Mercurifera Monte Amiata. In recent years the depletion of higher grade ore and high labor costs have made Italian mercury increasingly uncompetitive on the world market.

Metal production in 1974 was 24,950 flasks, a 24% decline from that of 1973, from ore that averaged 8.4 pounds of mercury per ton. Most of the production came from the Abbadia San Salvatore mine, with lesser quantities from the Solforate, Morone (Selvena), Bagnore, and Monte Labbro mines. About 1,000 workers were employed at the mines.

The Bagnore and Monte Labbro mines were shut down during the year and a modernization program was begun at the Solforate mine. By yearend work stopped in the remaining mines for about 1 month because of the large stock of metal, reportedly about 100,000 flasks.

Japan.—In late 1974 Japan's last mercury mine at Hokkaido was closed by Hokushin Mining Co. Consumption of mercury was reported to have declined drastically, especially in the chlor-alkali industry. About half of Japan's imports for the year came from Algeria.

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[7] Bailey, E. H., and V. A. Cammarota, Jr. International Mercury Congress. World Mining, v. 28, No. 1, January 1975, pp. 45–47.

Table 12.—Mercury: Exports from Italy, Spain, and Yugoslavia, by country

(Flasks)

Destination	Italy 1972	Italy 1973	Italy 1974	Spain 1972	Spain 1973	Spain 1974[1]	Yugoslavia 1972	Yugoslavia 1973	Yugoslavia 1974
Australia	--	--	NA	203	406	145	--	--	NA
Belgium-Luxembourg	1,102	667	NA	--	145	87	609	100	
Canada	--	--	--	754	174	588	--	--	
Colombia	([2])	--	NA	290	--	435	--	1,338	
Egypt	--	--	NA	--	--	145	--	--	
Finland	--	--	NA	--	145	--	--	--	
France	609	2,813	1,752	2,408	3,249	1,566	290	121	
Germany, East	--	1,799	4,302	2,002	2,843	--	--	--	
Germany, West	2,002	3,104	1,651	3,423	5,047	6,295	493	570	
Greece	--	--	NA	29	9	1	1,247	--	
Hungary	--	203	NA	174	--	--	--	600	
India	348	4,607	NA	3,278	3,916	8,006	--	--	
Iraq	--	--	NA	--	--	232	--	--	
Japan	261	3,075	NA	3,589	4,699	696	87	--	
Netherlands	290	899	400	377	377	580	--	--	
Poland	899	493	NA	696	377	1,392	--	--	
Portugal	--	--	NA	145	290	174	--	--	
Romania	899	--	NA	899	5,889	--	--	--	
South Africa, Republic of	--	580	NA	986	435	580	--	--	
Sweden	--	--	NA	2,175	2,060	1,595	--	--	
Switzerland	145	1,015	NA	580	928	609	290	200	
Taiwan	--	--	NA	203	232	986	--	--	
United Kingdom	3,017	406	4,798	6,759	7,165	4,061	899	--	
United States	145	870	1,671	1,044	7,165	4,032	9,486	9,917	
Venezuela	--	--	NA	--	1,595	--	--	--	
Other countries and undistributed	[3]1,218	176	2,613	609	1,327	582	261	705	
Total	10,935	20,707	17,187	30,623	48,473	32,787	13,662	13,551	9,515

NA Not available.

[1] Data for 9 months only.

[2] Less than ½ unit.

[3] Includes 1,015 flasks to Austria.

TECHNOLOGY

A new mineral, corderoite ($Hg_3S_2Cl_2$), from the Cordero mine in Humboldt County, Nev., was found in samples of mercury ore from the playa sediments.[8] The occurrence of corderoite in the deposit suggests that it is of low-temperature and/or supergene origin.

Techniques for removing mercury from effluent streams continued to be the main emphasis for research. Polyethylenimine-modified wool was found to have a great ability to adsorb mercury from aqueous solution.[9] Sorption from liquids passing through a column was rapid and effective at the 1-part-per-million level. The mercury was readily desorbed, and the wool could be used repeatedly.

Molecular sieves have been adapted to removing mercury from gaseous effluents.[10] In a typical chlorine plant application, the hydrogen gas is compressed and cooled to condense most of the mercury, after which the gas passes through the adsorber. The adsorbed mercury is released from the column by a blast of hot gas and returned to the plant for reuse.

Georgia-Pacific Corp., supported by a grant from EPA, completed tests on a new process for recovering up to 99% of the mercury formerly considered unrecoverable in the waste water and process sludge from the chlorine plant.[11]

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[8] Foord, E. E., P. Berendsen, and L. O. Storey. Corderoite, First Natural Occurence of α-$Hg_3S_2Cl_2$, From the Cordero Mercury Deposit, Humboldt County. Nev. Am. Miner., v. 59, Nos. 7–8, July–August 1974, pp. 652–655.

[9] Freeland, G. N., R. M. Hoskinson, and R. J. Mayfield. Adsorption of Mercury From Aqueous Solutions by Polyethylenimine-Modified Wool Fibers. Environmental Sci. and Technol., v. 8, No. 10, October 1974, pp. 943–944.

[10] Environmental Science and Technology. MS Has Come a Long Way. V. 8, No. 2, February 1974, pp. 106–107.

[11] Perry, R. Mercury Recovery From Contaminated Waste Water and Sludges. Environmental Protection Agency, EPA–660/2–74–086, December 1974, 119 pp.

Mica

By Stanley Haines[1]

Domestic production of mica[2] consisted of a small quantity of sheet mica from two States, and a larger quantity of scrap, flake, and ground mica. Production of scrap, flake, and ground mica declined significantly from 1973 levels.

Consumption of block and film mica, largely imported, decreased in both quantity and value in 1974, after a small upturn between 1972 and 1973. Consumption of mica splittings increased for the third consecutive year to the highest level since 1967. Exports of all classes of mica increased in both quantity and value. Imports of uncut sheet and punch mica were at the lowest levels since 1938. Scrap and manufactured mica imports increased in both quantity and value.

Legislation and Government Programs.—The Defense Materials Inventory stockpile objectives for all categories of sheet mica remained the same. The General Services Administration continued to dispose of sheet mica. Table 2 summarizes the Defense Materials Inventory for mica as of December 31, 1974.

Table 1.—Salient mica statistics

	1970	1971	1972	1973	1974
United States:					
Sold or used by producers:					
Sheet mica ----- thousand pounds --	--	17	14	[r] 30	W
Value ------------- thousands --	--	$7	$7	[r] $15	W
Scrap and flake mica thousand short tons --	119	127	[r] 148	[r] 153	137
Value ------------- thousands --	$2,527	$2,917	$4,353	$6,082	$5,475
Ground mica - thousand short tons --	115	[r] 119	[r] 130	[r] 137	117
Value ------------- thousands --	$7,350	$8,280	$8,844	$9,464	$10,171
Consumption:					
Block and film -- thousand pounds --	1,299	1,301	1,207	1,265	974
Value ------------- thousands --	$2,058	$2,259	$2,026	$2,106	$2,015
Splittings ------- thousand pounds --	5,214	4,177	4,324	5,178	6,186
Value ------------- thousands --	$2,254	$1,818	$1,771	$1,715	$2,801
Exports --------- thousand short tons --	9	8	7	8	9
Imports for consumption ------- do ----	6	7	5	6	7
World production ------- thousand pounds --	360,768	375,554	[r] 510,135	[r] 546,284	520,946

[r] Revised. W Withheld to avoid disclosing individual company confidential data.

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[1] Physical scientist, Division of Nonmetallic Minerals.

[2] Unless stipulated in the text, mica refers to the muscovite mica variety.

Table 2.—Defense Materials Inventory for sheet mica as of December 31, 1974
(Pounds)

Category	Stockpile objective	Total inventory	Uncommitted inventory
Muscovite block:			
Stained or better	1,600,000	[1]9,210,072	6,016,388
Stained or lower	--	484,351	192,265
Muscovite film:			
First and second qualities	418,000	[1]1,435,867	962,316
Third quality	--	219,850	--
Muscovite splittings	2,200,000	30,945,395	26,358,632
Phlogopite block	[2]51,000	[1]151,116	97,085
Phlogopite splittings	200,000	3,701,510	32,851,128

[1] Total inventory includes nonstockpile-grade materials: Muscovite block, stained or better, 878,704 pounds; muscovite film, first and second qualities, 640 pounds; and phlogopite block, 100,116 pounds.
[2] Includes 34,282 pounds nonstockpile-grade material.

DOMESTIC PRODUCTION

Sheet Mica.—A small quantity of sheet mica was produced in Connecticut and North Carolina. The sheet mica produced was generally of low quality and was derived from occasional pockets uncovered by quarry blasting at pegmatite feldspar operations. No mica was mined as the primary product of the producing company.

Scrap and Flake Mica.—Production of scrap and flake mica declined 11% from 1973, to 136,966 tons in 1974. The value of production declined 10%, from $6,081,893 in 1973 to $5,474,636 in 1974. North Carolina remained the leading scrap and flake mica producing State, with almost 56% of total production. The remaining output of scrap and flake mica came from Alabama, Arizona, Connecticut, Georgia, New Mexico, South Dakota, and South Carolina. Flake mica continued to be produced primarily from the beneficiation of pegmatite ores and clay deposits.

Ground Mica.—Sales of ground mica decreased 14% from the revised 1973 quantity of 136,501 tons to 117,363 tons in 1974. Total value of sales increased 7% over 1973, to $10,171,000 in 1974. Sixteen companies, operating a total of 18 plants, processed scrap and flake mica. Twelve of these plants produced dry-ground mica, four produced wet-ground mica, and two produced both wet- and dry-ground mica.

Table 3.—Mica sold or used by producers in the United States

Year and State	Sheet mica							
	Uncut punch and circle mica		Uncut mica larger than punch and circle		Total sheet mica		Scrap and flake mica [1]	
	Quantity (pounds)	Value	Quantity (pounds)	Value	Quantity (pounds)	Value	Quantity (short tons)	Value
1970	--	--	--	--	--	--	118,843	$2,527,450
1971	17,005	$6,652	--	--	17,005	$6,652	127,084	2,916,879
1972	14,280	7,140	--	--	14,280	7,140	[r] 147,883	4,353,318
1973	--	--	[r] 30,000	[r] $15,000	[r] 30,000	[r] 15,000	[r] 153,327	6,081,893
1974:								
Arizona	--	--	--	--	--	--	2,484	81,870
Connecticut	--	--	W	W	W	W	2,028	W
New Mexico	--	--	--	--	--	--	12,001	60,005
North Carolina	--	--	W	W	W	W	76,312	3,679,220
South Carolina	--	--	--	--	--	--	W	251,980
Other [2]	--	--	W	W	W	W	44,141	1,401,561
Total	--	--	W	W	W	W	136,966	5,474,636

[r] Revised. W Withheld to avoid disclosing individual company confidential data; included with "Other."
[1] Includes finely divided mica recovered from mica and sericite schist, and mica that is a by-product of feldspar and kaolin beneficiation.
[2] Includes Alabama, Connecticut (value), Georgia, South Carolina (tons), and South Dakota.

Table 4.—Ground mica sold by producers in the United States, by method of grinding [1]

Year	Dry-ground		Wet-ground		Total	
	Quantity (short tons)	Value (thousands)	Quantity (short tons)	Value (thousands)	Quantity (short tons)	Value (thousands)
1970	101,188	$5,070	13,905	$2,280	115,093	$7,350
1971	[r] 103,308	5,463	16,176	2,817	[r] 119,484	8,280
1972	[r] 104,625	5,500	25,649	3,343	[r] 130,274	[2] 8,844
1973	[r] 120,762	[r] 6,469	[r] 15,739	2,995	[r] 136,501	[r] 9,464
1974	[r] 101,455	6,335	15,908	3,836	117,363	10,171

[r] Revised.

[1] Domestic and some imported scrap.

[2] Data may not add to total shown because of independent rounding.

CONSUMPTION AND USES

Sheet Mica.—Fabrication of block and film mica declined 23% from 1973, to 973,928 pounds in 1974. Of the total consumption, 93% was muscovite block, 6% was phlogopite (magnesium mica) block, and 1% was muscovite film.

Vacuum tubes required 64% of the total muscovite block fabricated. The remaining fabricated muscovite block was used in gage glass and diaphragms 3%, capacitors 1%, and other uses 32%. Lower than Stained quality muscovite block mica was in greatest demand and accounted for almost 66% of consumption; Stained, 33%; and Good Stained or better, 1%.

Muscovite film consumption declined 15%, from 10,148 pounds in 1973 to 8,671 pounds in 1974. The film was primarily consumed in the fabrication of capacitors.

Muscovite block and film were consumed by 13 companies in 7 States. In 1974, New Jersey with four consuming plants, New York with three, North Carolina with two, and Pennsylvania with one consumed 75% of the total domestically fabricated block and film. Phlogopite block consumption dropped from 69,899 pounds in 1973 to 62,513 pounds in 1974. Phlogopite was consumed by six companies in five States. Virginia and New Jersey were the primary fabricating States.

Consumption of mica splittings, both muscovite and phlogopite, increased for the third consecutive year, from 5,178,000 pounds in 1973 to 6,186,000 pounds in 1974. India and the Malagasy Republic supplied the bulk of the splittings consumed domestically. Splittings were fabricated into various built-up mica products by 11 companies with 12 plants in 8 States. Six companies with six plants located in New Hampshire, New York, and Ohio consumed 4.9 million pounds of splittings, or 80% of total consumption.

Built-up-Mica.—This mica-based substitute was produced in various forms, primarily for use as electrical insulating material. Production of all major built-up mica products increased in quantity and value. The forms of built-up mica in greatest demand were segment plate 29%, molding plate 25%, and tape 24%.

Reconstructed Mica.—Three companies continued to manufacture this mica-based alternate material from good-quality delaminated scrap mica. The manufacturing companies were General Electric Co. at Schenectady, N.Y.; Samica Corp. at Rutland, Vt.; and Acim Paper Corp. at New Hyde Park, N.Y. There were no published data available relating to the quantity and value of the reconstituted mica produced during the year.

Ground Mica.—Ground mica for use in construction-related industries declined significantly. Sales of ground mica used for roofing materials, paint, and joint cement declined 55%, 10%, and 20%, respectively.

Table 5.—Fabrication of muscovite ruby and nonruby block and film mica and phlogopite block mica by quality and end-product use in the United States in 1974

(Pounds)

Variety, form, and quality	Electronic uses				Nonelectronic uses			Grand total
	Capacitors	Tubes	Other	Total	Gage glass and diaphragms	Other	Total	
Muscovite:								
Block:								
Good Stained or better	162	1,222	1,875	3,259	2,561	--	2,561	5,820
Stained	444	263,162	35,921	299,527	4,452	60	4,512	304,039
Lower than Stained [1]	5,664	317,373	171,470	494,507	17,464	80,914	98,378	592,885
Total	6,270	581,757	209,266	797,293	24,477	80,974	105,451	902,744
Film:								
First quality	2,104	950	1,120	4,174	--	--	--	4,174
Second quality	3,297	--	--	3,297	--	--	--	3,297
Other quality	1,200	--	--	1,200	--	--	--	1,200
Total	6,601	950	1,120	8,671	--	--	--	8,671
Block and film:								
Good Stained or better [2]	5,563	2,172	2,995	10,730	2,561	--	2,561	13,291
Stained [3]	1,644	263,162	35,921	300,727	4,452	60	4,512	305,239
Lower than Stained	5,664	317,373	171,470	494,507	17,464	80,914	98,378	592,885
Total	12,871	582,707	210,386	805,964	24,477	80,974	105,451	911,415
Phlogopite: Block (all qualities)	--	--	56	56	--	62,457	62,457	62,513

[1] Includes punch mica.
[2] Includes first- and second-quality film.
[3] Includes other-quality film.

Table 6.—Fabrication of muscovite ruby and nonruby block and film mica in the United States in 1974, by quality and grade

(Pounds)

Form, variety, and quality	No. 4 and larger	No. 5	No. 5½	No. 6	Other [1]	Total
Block:						
Ruby:						
Good Stained or better	1,513	872	330	1,020	--	3,735
Stained	7,626	54,375	87,360	149,605	6,920	305,886
Lower than Stained	11,851	104,842	80,293	184,764	122,623	504,373
Total	20,990	160,089	167,983	335,389	129,543	813,994
Nonruby:						
Good Stained or better	1,031	45	--	700	--	1,776
Stained	1,253	5,198	1,100	3,619	--	11,170
Lower than Stained	19,492	14,438	924	6,300	34,650	75,804
Total	21,776	19,681	2,024	10,619	34,650	88,750
Film:						
Ruby:						
First quality	1,129	325	150	200	--	1,804
Second quality	466	766	790	125	--	2,147
Other quality	--	--	--	--	1,200	1,200
Total	1,595	1,091	940	325	1,200	5,151
Nonruby:						
First quality	1,120	--	450	800	--	2,370
Second quality	--	--	1,150	--	--	1,150
Other quality	--	--	--	--	--	--
Total	1,120	--	1,600	800	--	3,520

[1] Figures for block mica include all smaller than No. 6 grade and "punch" mica.

Table 7.—Consumption and stocks of mica splittings in the United States, by source

(Thousand pounds and thousand dollars)

	India		Malagasy		Total	
	Quantity	Value	Quantity	Value	Quantity	Value
Consumption:						
1970	5,013	2,109	202	144	[1] 5,214	[1] 2,254
1971	4,084	1,750	93	68	4,177	1,818
1972	4,245	1,653	79	118	4,324	1,771
1973	5,063	1,606	115	109	5,178	1,715
1974	6,026	2,673	160	128	6,186	2,801
Stocks Dec. 31:						
1970	W	NA	W	NA	2,013	NA
1971	1,317	NA	98	NA	1,415	NA
1972	1,723	NA	86	NA	1,809	NA
1973	1,246	NA	55	NA	1,301	NA
1974	3,170	NA	87	NA	3,257	NA

NA Not available. W Withheld to avoid disclosing individual company confidential data.

[1] Data may not add to total shown because of independent rounding.

Table 8.—Built-up mica[1] sold or used in the United States, by product

(Thousand pounds and thousand dollars)

Product	1973		1974	
	Quantity	Value	Quantity	Value
Molding plate	1,109	2,274	1,549	3,977
Segment plate	1,105	2,279	1,786	3,876
Heater plate	W	W	W	W
Flexible (cold)	683	1,598	843	1,976
Tape	W	W	1,442	4,508
Other	1,649	4,718	479	1,383
Total[2]	4,547	10,869	6,099	15,720

W Withheld to avoid disclosing individual company confidential data, included with "Other."

[1] Consists of alternative layers of binder and irregularly arranged and partly overlapped splittings.

[2] Data may not add to totals shown because of independent rounding.

Table 9.—Ground mica sold by producers in the United States, by use

Use	1973		1974	
	Quantity (short tons)	Value (thousands)	Quantity (short tons)	Value (thousands)
Roofing	21,582	$792	9,677	$445
Wallpaper	481	73	W	W
Rubber	5,719	1,009	6,605	1,427
Paint	37,418	3,392	33,553	3,319
Plastics	401	80	W	W
Welding rods	W	W	W	W
Joint cement	51,116	2,879	40,744	2,727
Other[1]	r 19,911	1,239	26,784	2,252
Total	r 136,628	9,464	117,363	[2] 10,171

W Withheld to avoid disclosing individual company confidential data; included with "Other."

[1] Includes mica used for molded electric insulation, annealing, well drilling, textile and decorative coating, texture paint, and uses indicated by symbol W.

[2] Data may not add to total shown because of independent rounding.

STOCKS

At yearend there was about 3.9 million pounds of sheet mica in fabricators' stocks. Of this total 84% was splittings, 15.5% was block, and 0.5% was film. This information was obtained by direct canvass of sheet mica fabricators. Similar information is not available for scrap, flake and ground mica. It is estimated that producers maintain inventories of ground mica equal to 5% to 10% of production.

PRICES

The average value of imported muscovite sheet in 1974, based on consumption data, follows: Block, $2.04 per pound; film, $4.36 per pound; and splittings, $0.44 per pound. The average value of phlogopite sheet mica, also based on consumption data, follows: Phlogopite block, $2.13 per pound; and phlogopite splittings, $0.80 per pound.

The average value of scrap and flake mica produced during 1974 was $39.96 per ton. Prices for wet-ground mica quoted in the Chemical Marketing Reporter showed significant increases from 1973. Dry-ground prices remained about the same as 1973. Yearend prices are shown in table 10.

Table 10.—Price of dry- or wet-ground mica in the United States in 1974 [1]

	Cents per pound
Dry-ground:	
Joint cement, 100 mesh	4–5
Plastic, 100 mesh	4–5
Roofing, 20 to 80 mesh	2–3½
Wet-ground: [2]	
Paint or lacquer, 325 mesh	11–13
Rubber	11–13
Wall paper	12–18

[1] In bags at works, carlots, unless otherwise noted.

[2] Freight allowed east of the Mississippi River.

Source: Chemical Marketing Reporter. V. 206, No. 27, Dec. 30, 1974.

FOREIGN TRADE

Total mica exports, as summarized in table 11, increased 14% in quantity and 24% in value over the 1973 figures. Over 50% of the sheet, scrap, flake, and ground mica exported was shipped to Canada, Singapore, and France. Reported export data did not provide information on the grade or type of mica exported, but it is assumed that the major portion of the material exported was ground mica.

Imports of scrap and waste mica increased 31% over those of 1973. Imports of sheet mica decreased 32% in quantity and 25% in value below 1973 levels. Processed mica imports increased 37% in quantity and 14% in value. There have been no imports of phlogopite waste and scrap since 1972.

Table 11.—U.S. exports of mica and manufactures of mica in 1974, by country

Destination	Mica, including block, film, splittings, waste, scrap and ground mica		Manufactured	
	Quantity (pounds)	Value (thousands)	Quantity (pounds)	Value (thousands)
Algeria	600,000	$19	--	--
Angola	50,539	7	--	--
Argentina	67,203	47	17,443	$46
Australia	54,053	8	70,437	97
Belgium-Luxembourg	238,850	29	37,614	37
Brazil	6,076	2	42,956	135
Canada	4,835,833	514	333,775	1,079
Chile	89,365	7	1,404	2
Colombia	70,900	11	5,826	21
Denmark	--	--	16,681	96
Dominican Republic	48,353	13	2,525	4
Ecuador	41,347	6	--	--
France	1,109,604	78	15,425	131
Germany, West	507,271	93	11,115	25
Ghana	49,310	6	608	2
Guatemala	64,900	6	--	--
Guyana	40,000	5	501	2
Hong Kong	52,948	83	--	--
Hungary	49,640	115	--	--
Indonesia	20,000	2	10	1
Iran	248,918	29	--	--
Iraq	88,200	9	--	--
Italy	355,008	93	52,697	215

Table 11.—U.S. exports of mica and manufactures of mica in 1974, by country—Continued

Destination	Mica, including block, film, splittings, waste, scrap and ground mica		Manufactured	
	Quantity (pounds)	Value (thousands)	Quantity (pounds)	Value (thousands)
Jamaica	36,200	$35	46,840	$72
Japan	319,480	390	8,942	26
Mexico	646,244	76	185,468	667
Netherlands	597,551	181	2,083	17
New Zealand	50,000	7	981	4
Norway	137,773	16	1,804	7
Peru	42,185	23	5,524	16
Philippines	66,500	15	4,070	28
Saudi Arabia	149,937	13	531	1
Singapore	3,730,277	417	52	1
South Africa, Republic of	39,942	9	37,983	55
Spain	204,469	36	70,972	257
Sweden	34,980	10	2,460	16
Switzerland	37,358	28	28,410	59
Taiwan	15,948	19	3,971	11
Trinidad and Tobago	15,392	3	898	6
United Arab Emirates	247,600	27	102	1
United Kingdom	677,921	490	30,066	249
Venezuela	774,256	62	2,518	6
Other	280,532	46	11,288	48
Total	16,842,858	3,085	1,053,980	3,430

Table 12.—U.S. exports and imports of mica

(Thousand pounds and thousand dollars)

Year	Exports		Imports for consumption					
	All classes		Uncut sheet and punch		Scrap		Manufactured	
	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value
1972	14,959	4,752	1,494	1,162	2,641	62	5,644	3,183
1973	15,744	5,265	1,169	1,269	5,072	116	4,785	4,325
1974	17,897	6,515	794	947	6,634	193	6,555	4,928

Table 13.—U.S. imports for consumption of mica, by kind and country

Year and country	Unmanufactured									
	Waste and scrap						Other			
	Phlogopite		Other		Block mica		Muscovite		Other, n.e.c.	
	Quantity (pounds)	Value (thousands)	Quantity (pounds)	Value (thousands)	Quantity (pounds)	Value (thousands)	Quantity (pounds)	Value (thousands)	Quantity (pounds)	Value (thousands)
1972	112,000	$4	2,529,399	$58	895,661	$946	109,768	$4	488,351	$212
1973	--	--	5,072,912	116	994,661	1,050	47,315	28	126,689	191
1974:										
Argentina	--	--	220,460	6	--	--	--	--	--	--
Brazil	--	--	2,255,430	81	521,308	612	48,320	19	43,623	90
Canada	--	--	494,800	8	--	--	--	--	39,900	([1])
Haiti	--	--	--	--	2,441	1	--	--	--	--
India	--	--	3,508,767	94	53,112	101	1,600	2	22,368	28
Malagasy Republic	--	--	--	--	5,971	10	--	--	52,458	72
Sri Lanka	--	--	154,316	4	--	--	--	--	--	--
Tanzania	--	--	--	--	--	--	--	--	2,279	12
Total	--	--	6,633,773	193	582,832	724	49,920	21	160,628	202

See footnotes at end of table.

Table 13.—U.S. imports for consumption of mica, by kind and country—Continued

Year and country	Manufactured							
	Splittings		Not cut or stamped, not over 0.006 inch in thickness		Cut or stamped			
					Not over 0.006 inch in thickness		Over 0.006 inch in thickness	
	Quantity (pounds)	Value (thousands)	Quantity (pounds)	Value (thousands)	Quantity (pounds)	Value (thousands)	Quantity (pounds)	Value (thousands)
1972	4,561,968	$1,128	6,572	$16	96,116	$1,445	105,726	$165
1973	3,628,802	881	15,714	30	142,365	2,411	133,738	260
1974:								
Brazil	121	1	3,307	2	--	--	--	--
Canada	--	--	--	--	--	--	2,780	12
Haiti	--	--	1,172	7	522	7	--	--
Hong Kong	--	--	--	--	110	3	--	--
India	4,896,976	1,236	3,150	4	120,406	1,991	148,256	244
Israel	--	--	--	--	--	--	60	1
Japan	--	--	67,910	22	--	--	40	1
Macao	--	--	--	--	449	16	--	--
Malagasy Republic	78,521	81	200	2	42	1	--	--
Taiwan	--	--	--	--	640	20	--	--
United Kingdom	--	--	--	--	765	18	517	7
Total	4,970,618	1,318	75,739	37	122,934	2,056	151,603	265

Year and country	Mica plates and built-up mica		Ground or pulverized		Articles not especially provided for of mica	
	Quantity (pounds)	Value (thousands)	Quantity (pounds)	Value (thousands)	Quantity (pounds)	Value (thousands)
1972	294,424	$274	22,046	(1)	556,984	$160
1973	614,455	620	223,882	$14	25,630	109
1974:						
Australia	--	--	--	--	37	3
Austria	867,735	862	--	--	14	1
Belgium-Luxembourg	--	--	--	--	43,378	21
Canada	10,556	29	119,950	11	7,059	18
France	--	--	--	--	2,348	11
Germany, West	24,686	56	--	--	21,018	45
Hong Kong	--	--	--	--	3,050	9
India	--	--	81,690	3	13,958	135
Japan	70	(1)	--	--	73	5
Netherlands	--	--	--	--	109	13
South Africa, Republic of	--	--	22,046	2	--	--
United Kingdom	3,063	4	--	--	11,798	24
Total	906,110	951	223,686	16	102,832	285

[1] Less than ½ unit.

WORLD REVIEW

World production of all forms of mica declined more than 4% from 1973 to 1974. India remained the world leader for production of sheet mica. The United States continued as the major world producer of scrap and flake mica.

India.—The Mica Trading Corp. (MITCO) was established as a subsidiary of the Minerals and Metals Trading Corp. (MMTC) to handle marketing of mica. The floor price for mica was increased 40% in February, with another rise expected in January 1975.

Exports of all forms of mica increased in 1974. It was estimated that almost 60% of the exports were taken by East Germany, Czechoslovakia, Hungary, Romania, the U.S.S.R., and Bulgaria.[3]

Malagasy Republic.—Malagasy remained the major world source of phlogopite mica with production of almost 1.9 million pounds of block, splittings, and scrap during the year. Over 64% of production consisted of splittings; the remainder was block and scrap.

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[3] Industrial Minerals. Mica Sales Are Booming to the Eastern Bloc. March 1975, No. 90, p. 9.

Table 14.—Mica: World production, by country

(Thousand pounds)

Country[1]	1972	1973	1974[p]
Argentina:			
Sheet	256	959	e 880
Waste, scrap, etc.	r 5,820	5,523	e 5,510
Brazil[2]	r 5,690	3,834	e 3,970
Colombia	84	e 90	e 90
France	8,655	r e 8,820	e 8,820
Guatemala	2,639	e 2,600	e 2,600
India:			
Exports:			
Block[3]	3,309	1,770	2,077
Splittings[4]	14,285	11,215	13,761
Scrap[5]	38,354	49,743	62,534
Domestic consumption, all classes e	r 18,740	r 21,160	23,810
Total e	r 74,688	r 83,888	102,182
Korea, Republic of (sericite)	4,068	13,938	5,952
Malagasy Republic (phlogopite):			
Block	r 128	276	333
Splittings	r 752	1,248	1,215
Scrap	r 412	439	340
Mexico	1,821	1,724	1,861
Mozambique (including scrap)	r 507	683	1,883
Nepal	NA	18	9
Norway (including scrap)[2]	r 9,096	9,800	e 9,920
Portugal	3,651	r e 3,750	e 3,750
South Africa, Republic of:			
Sheet	4	(6)	2
Scrap	9,359	13,248	6,327
Sri Lanka	428	600	e 660
Sudan	NA	NA	551
Tanzania:			
Sheet	r 40	71	20
Scrap e	29	29	29
U.S.S.R. (all grades) e	86,000	88,000	90,000
United States:			
Sheet	14	30	W
Scrap and flake	r 295,766	306,654	273,932
Yugoslavia	278	62	e 110
Total	r 510,135	r 546,284	520,946

e Estimate. p Preliminary. r Revised. NA Not available. W Withheld.

[1] In addition to the countries listed, the People's Republic of China, Romania, Southern Rhodesia, Territory of South-West Africa, and Sweden are known to produce mica, but available information is inadequate to make reliable estimates of output levels.

[2] Exports.

[3] Includes micanite and other built-up mica.

[4] Includes condenser film, washer, and disks.

[5] Includes sheet, strips, and powder.

[6] Less than ½ unit.

TECHNOLOGY

A combination of synthetic mica and special glass has resulted in a new high-temperature electrical insulating material. This material, developed as a substitute for fired circuits, not only can withstand temperatures as high as 1,100° F, but it is also arc resistant, nontracking, noncombustible, and lightweight.[4]

The Wet-Ground Mica Association reported two experimental new uses of wet-ground mica. The first use involves wet-ground mica spread around crops to help control aphid infestation instead of the previously used aluminum foil. The other new development involves mica used as a shading compound on greenhouses. The ground mica is deposited on greenhouses during periods of intense sunlight that may damage the plants inside. The mica allows enough light for plant growth, but will lower the intensity below harmful levels. The mica is easily removed when no longer needed.

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[4] Materials Engineering. Nonmetallics News. V. 80, No. 7, December 1974, p. 52.

Molybdenum

By Andrew Kuklis [1]

World molybdenum consumption rose to an estimated 200 million pounds, apparently due to increased use of high-strength, low-alloy steel in energy related applications, principally the manufacture of large-diameter line pipe for hydrocarbons transmission. For the second consecutive year, consumption exceeded production. Molybdenum output as a byproduct was considerably lower in 1974 because of a drop in demand for copper, the primary associated mineral. World industrial and domestic government stocks were reduced significantly. Molybdenum production facilities were being expanded in many parts of the world.

Table 1.—Salient molybdenum statistics
(Thousand pounds contained molybdenum and thousand dollars)

	1970	1971	1972	1973	1974
United States:					
Concentrate:					
Production	111,352	109,592	112,188	115,859	112,011
Shipments	110,381	97,882	102,197	135,097	118,163
Value	$190,077	$164,917	$170,530	$217,721	$234,658
Consumption	76,101	66,399	62,560	82,477	91,706
Imports for consumption	25	854	385	458	155
Stocks, Dec. 31: Mine and plant	9,715	29,077	45,243	21,998	13,407
Primary products:					
Production	75,383	67,016	64,841	85,046	88,509
Shipments	76,095	66,654	75,538	108,687	114,799
Consumption	45,337	40,950	45,558	57,049	63,476
Stocks, Dec. 31: Producers	25,904	31,048	28,898	22,387	16,078
World: Production	181,429	171,064	[r] 178,428	[r] 184,122	188,274

[r] Revised.

Legislation and Government Programs.—The General Services Administration (GSA) disposed of over 35 million pounds of molybdenum from the Government's stockpile. Most was sold to domestic producers under long-term, buy-back agreements negotiated during the year. At yearend, molybdenum in the national stockpile totaled 2.1 million pounds. The material was expected to be available for sale periodically on a sealed-bid basis to producers, processors, and consumers. GSA stockpiles contained an additional 3.7 million pounds of molybdenum material that was classed as sold, but was unshipped.

Table 2.—U.S. Government molybdenum stockpile material inventories on Dec. 31, 1974
(Thousand pounds, contained molybdenum)

Type material	National (strategic stockpile)
Molybdenum (disulfide)	1,798
Molybdenum (ferro)	291
Molybdenum (oxide)	--
Total	2,089

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[1] Physical scientist, Division of Ferrous Metals.

Table 3.—U.S. Government molybdenum stockpile material sold, but unshipped on Dec. 31, 1974 [1]

(Thousand pounds, contained molybdenum)

Type material	National (stockpile stockpile)
Molybdenum (disulfide)	2,332
Molybdenum (ferro)	479
Molybdenum (oxide)	930
Total	3,741

[1] Not included in table 2.

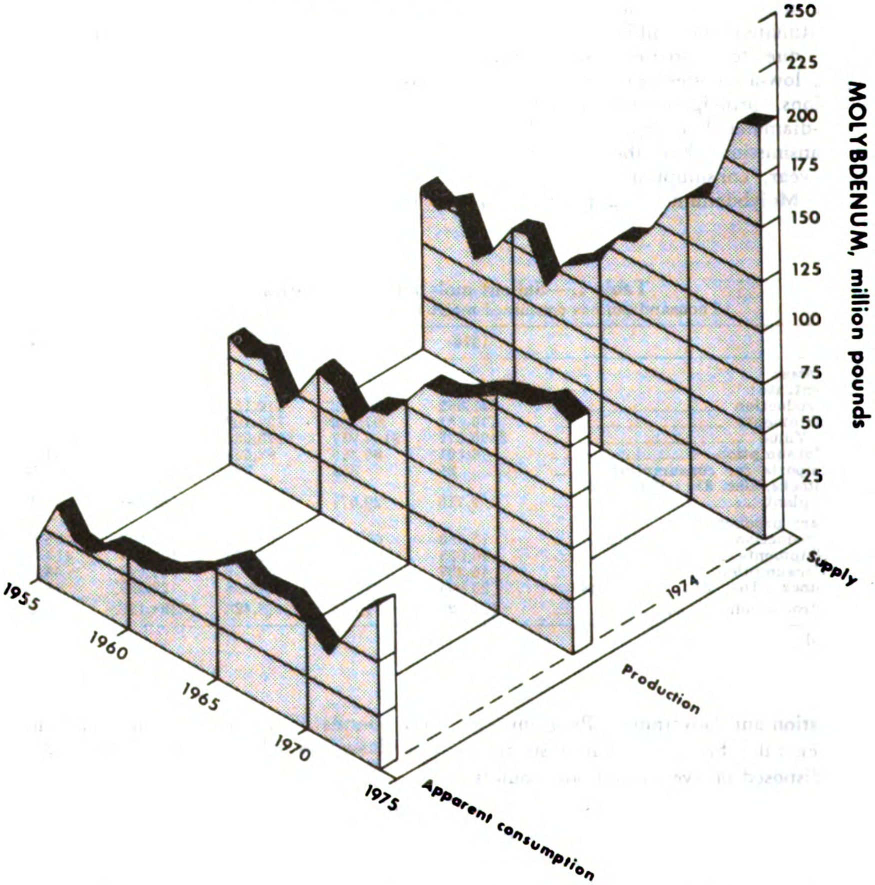

Figure 1.—Apparent consumption, production, and supply of molybdenum in the United States.

DOMESTIC PRODUCTION

Molybdenum output in concentrate declined nearly 4 million pounds from the 1973 record production year. Production from primary sources rose significantly but failed to offset lower output at byproduct plants. One byproduct plant reportedly did not recover molybdenum in 1974.

Ores processed at concentrators for molybdenum totaled over 192 million tons; the bulk consisting of byproduct ores. The concentrators recovered over 112 million pounds of molybdenum, 3% less than the quantity recovered in 1973. Of the total output in 1974, about 34% was as a byproduct from ores of copper, tungsten, and uranium, and the remaining 66% was recovered from ores processed for molybdenum.

Molybdenum output from primary ore rose nearly 11% compared with that of 1973. Three operations processed nearly 22 million tons of ore from which over 74 million pounds of molybdenum was recovered. The Urad mine was operated at reduced levels during the year and subsequently closed at yearend. Output at the Climax mine, the world's largest underground molybdenum operation, rose nearly 17% over that of 1973. The record production at Climax prevented a decline in output from primary sources.

Output of molybdenum at byproduct plants decreased over 11 million pounds compared with that of 1973. Lower production was due principally to a drop in demand for copper, an associated metal. Byproduct molybdenum from copper porphyry ores was recovered by 9 companies at 13 plants, 1 plant less than in 1973. The Inspiration facility of Inspiration Consolidated Copper Co. did not recover molybdenum in 1974. Of the 13 plants, only 2 increased their output, the remaining 11 plants had lower production compared with 1973 output. Lower production also was reported at uranium and tungsten byproduct operations.

The Sierrita mine of Duval Sierrita Corp. was the largest byproduct producer. The Utah mine of Kennecott Copper Corp. and the San Manuel mine of Magma Copper Co. ranked second and third, respectively. These three mines were responsible for about two-thirds of the byproduct molybdenum produced in the United States. Six companies, two primary and four byproduct producers, accounted for over 97% of the domestic output or 61% of the world output of molybdenum in 1974.

Demand for molybdenum remained strong during 1974 because of record consumption by the domestic steel industry and large exports to foreign markets. The molybdenum industry continued expanding production facilities to meet this demand, both in the mining and manufacturing sectors.

New labor contracts were negotiated in 1974 for most molybdenum industry employees. At midyear, some production was lost at byproduct plants because of a shutdown during prolonged contract negotiations. These labor agreements were expected to provide a climate for uninterrupted molybdenum production through 1977.

Molybdenum Corporation of America (Molycorp) reported a record output of 11.2 million pounds of molybdenum at its Questa open pit mine in New Mexico. A modified mining system was employed by the company to increase molybdenum production and to lower mining costs. Exploratory drilling was conducted during the year to increase ore reserves. The company completed 19 diamond drill holes in a new mineralized zone adjacent and to the southwest of the open pit mine. Twelve holes intersected a thick mineralized zone averaging 0.32% molybdenite. Exploratory drilling and other investigative work was continued into 1975. On completion of the program, a feasibility study was to be made to ascertain tonnage, grade, waste-to-ore ratio, and other operating parameters in preparation for expanding production at the property.

At midyear, construction was underway to build a molybdenum conversion plant on a 500-acre site near Ft. Madison, Iowa, by AMAX Specialty Metals Corp., a division of AMAX, Inc. The facility will produce 3.5 million pounds of ammonium molybdate and other derivative products for use in the chemical, metallurgical, and petroleum industries. It was expected to be the world's largest and most modern plant for manufacturing molybdate products; completion was scheduled for early in 1975.

The modernization program at AMAX's

Langeloth, Pa., roasting facility was continued. Most of the major equipment was to be replaced, and processes were to be automated. It was reported that over $10 million was authorized for pollution control and related equipment. Oxides of sulfur will be removed from the flue gases and converted to sulfuric acid by a contact process. Additional equipment will be installed to recover molybdenum contained in the flue gases. Expenditures for construction of the new Fort Madison plant and modernization of processing and roasting operations at Langeloth were estimated at over $50 million.

AMAX, Inc. continued both development and mining operations at its Climax open pit mine. Additional ore headings and haulage roads were prepared to increase production. At yearend, output of molybdenum ore reportedly rose to 7,000 tons per day. Underground mining operations were accelerated to increase ore production because of increased demand for molybdenum and anticipated closing of the Urad mine. Mining on the Phillipson level was discontinued due to exhaustion of ore reserves. Total molybdenum output for 1974 at the Climax property, open pit and underground, rose 8.5 million pounds compared with that of 1973.

The Urad molybdenum mine, operated by AMAX, Inc., was closed on November 29, 1974, because of exhaustion of ore reserves. The mine was developed at a cost of $30 million in 1967 to alleviate a shortage of molybdenum. Urad's ore supply was known to be limited to about 6 to 7 years of production. Employees were expected to be transferred to the nearby Henderson molybdenum mine currently under development. Urad's output of molybdenum totaled nearly 50 million pounds for the 1967 to 1974 period. At yearend, a comprehensive land reclamation program, costing $6 million, was underway at the mine site. The work will include landfill, reseeding, and closing of mine openings.

Development at the Henderson molybdenum mine near Empire, Colo., was continued. Projects underway included construction of an ore haulage tunnel, developing additional production headings in the ore body, and building a concentrator. At yearend, about 85% of the 10-mile-long tunnel was completed. Tunnel construction was conducted in two directions, from the mine by AMAX employees and from the concentrator by a contractor. AMAX employed 4 crews of 25 men each and worked 7 days per week in driving the tunnel. Dravo Corp., a mine development contractor, was driving the 15- by 16-foot tunnel from the concentrator to the mine. Steel arch sets on 4-foot centers were used for ground support. Drilling was conducted with a four-machine jumbo and the blasted rock was loaded by a belt-loader onto a train of cars for transportation to an outside muck pile. The two tunnels were expected to meet early in the second quarter of 1975. A considerable footage of headings have been completed in preparation for mining of the ore body.

Harrison Western Corp., an international mine development contractor, initiated construction of the No. 3 shaft at midyear at the Henderson mine. The 23-foot diameter shaft will be sunk to a depth of 2,300 feet and will be utilized for ventilation purposes.

Duval Corporation started construction of a ferromolybdenum production plant adjacent to the Sierrita and Esperanza mine, mill, and roaster complex near Sahuarita, Ariz. The facility will utilize an exothermic process in producing ferromolybdenum at a rate of 3.5 million pounds per year. Startup operations were scheduled for the second quarter of 1975.

Cyprus Bagdad Copper Co., formerly Bagdad Copper Corp., was expanding mining and milling operations at its Bagdad facility, 70 miles west of Prescott, Ariz. Fluor Utah, Inc., and Holmes & Narver, Inc., were engaged to provide design, procurement, and engineering services for the project. An automated concentrator, capable of processing 40,000 tons of copper-molybdenum ore, will contain primary crushing, autogenous grinding, standard flotation, concentrate handling, and molybdenum recovery sections. Ancillary facilities scheduled for construction include a tailings disposal and water recycling system, warehouse, mine and mill offices and shops, and an enlarged employees residential community. The project, costing an estimated $200 million, was expected to be completed late in 1977.

Cyprus Mines Corp. initiated a feasibility study on treating byproduct molybdenum concentrate by the Cymoly process. The Cymoly process was developed by Molycorp to produce pure molybdenum oxide from low-grade molybdenum concentrate. Pilot-plant tests have been conducted on concentrate by Cyprus Mines Corp.'s engineers at the Washington, Pa., plant of Molycorp.

Cyprus Mines Corp. continued surface and underground exploratory drilling to further delineate the mineralized zone at its Thompson Creek molybdenum prospect in central Idaho. A feasibility study was completed to determine the economic parameters of the property at mining rates of 20,000 tons and upward. A estimated $70 to $75 million would be required to develop Thompson Creek.

S.W. Shattuck Chemical Co. Inc., a subsidiary of Engelhard Minerals & Chemical Corp., planned to spend $500,000 for expanding its molybdenum and rhenium product manufacturing facilities. Included in the expansion was installation of a crystallizer which would double capacity for molybdate output. The company purchases byproduct molybdenum concentrate to produce ammonium and sodium molybdates, high-purity molybdic oxide, and rhenium compounds.

Table 4.—Production, shipments, and stocks of molybdenum products in the United States
(Thousand pounds contained molybdenum)

	1973	1974	1973	1974	1973	1974
	Molybdic oxide [1]		Metal powder		Ammonium molybdate	
Received from other producers	10,645	14,048	200	41	1,681	1,766
Gross production during year	133,615	138,039	4,571	3,727	8,174	4,080
Used to make other products listed here	70,335	71,661	940	774	4,567	2,555
Net production	63,280	66,378	3,631	2,953	3,607	1,525
Shipments	84,353	88,845	3,658	2,861	3,484	3,115
Producer stocks, Dec. 31	17,312	10,601	586	559	542	635
	Sodium molybdate		Other [2]		Total	
Received from other producers	166	20	1,785	3,732	14,477	19,607
Gross production during year	1,539	1,808	16,154	17,624	164,053	165,278
Used to make other products listed here	1	24	3,164	1,755	79,007	76,769
Net production	1,538	1,784	12,990	15,869	85,046	88,509
Shipments	1,593	1,631	15,599	18,347	108,687	114,799
Producer stocks, Dec. 31	280	143	3,667	4,140	22,387	16,078

[1] Includes molybdic oxide, briquets, molybdic acid, and molybdenum oxide.
[2] Includes ferromolybdenum, calcium molybdate, phosphomolybdic acid, molybdenum disulfide, pellets, molybdenum pentachloride, and molybdenum hexacarbonyl.

CONSUMPTION AND USES

Domestic consumption of molybdenum in concentrate rose 11% compared with 1973 figures. Most of the concentrate, except that consumed in the production of purified molybdenum disulfide, was converted to molybdic oxide for direct use or to produce other molybdenum products. Output of purified molybdenum disulfide for lubricant purposes declined significantly compared with that of 1973.

Domestic end use consumption of molybdenum materials rose 6.4 million pounds in 1974 and was 11% higher than in 1973 (table 5). The increase in 1974 was the third consecutive consumption increase. It was due to higher output of steel, and specifically to increased use of high-strength, low-alloy steel for large-diameter line pipe. Molybdenum consumed in carbon, alloy, and stainless steels rose 35%, 13%, and 18%, respectively, compared with that of 1973. The percent increase in other steel-consuming sectors was in line with that of total consumption. Steel manufacturers take advantage of unique properties that molybdenum imparts to steel such as hardenability, corrosion resistance, strengthening, and toughness.

Development of new markets to increase consumption of molybdenum for chemical and metallurgical applications was continued. A new ferritic stainless steel containing 2% molybdenum was marketed for use in the manufacture of hotwater tanks, water tubes, heat exchangers, and other chemical processing equipment.

Researchers were investigating the use of special molybdenum steels in automobile engines designed for nonleaded fuels, for rock-drilling products, and higher strength steel pipe for use in drilling oil and gas wells to greater depths.

The Pesses Co., supplier of ferroalloys and specialty metal products, announced it was establishing a manufacturing operation at Solon, Ohio. Molybdenum ferroalloys would be among the company's principal products. The company has obtained molybdenum products from outside sources, but increased shipping costs led to the decision to manufacture its own molybdenum.

Battelle Memorial Institute installed a furnace muffle at its isostatic processing system laboratory in Columbus, Ohio. The structure, 4½ feet in diameter and 12½ feet in height, was the largest on record fabricated for commercial applications from a molybdenum alloy. It will be used in conjunction with a furnace operating at temperatures in excess of 2,400° F and at a pressure of 15,000 pound per square inch (psi).

Table 5.—Consumption of molybdenum materials, by end use in 1974
(Thousand pounds contained molybdenum)

End use	Molybdic oxides	Ferromolybdenum [1]	Ammonium and sodium molybdate	Other molybdenum materials [2]	Total
Steel:					
Carbon	1,402	477	--	15	1,894
Stainless and heat resisting	7,804	2,127	--	112	10,043
Full alloy	22,335	1,960	--	207	24,502
High-strength low-alloy	2,580	499	--	29	3,108
Electric	477	107	--	--	584
Tool	3,798	1,212	--	70	5,080
Cast irons	936	3,629	--	101	4,666
Superalloys	1,232	664	--	1,699	3,595
Alloys (excludes steels and superalloys):					
Welding and alloy hard-facing rods and materials	--	343	--	46	389
Other alloys [3]	72	459	--	115	646
Mill products made from metal powder	--	--	--	3,081	3,081
Chemical and ceramic uses:					
Pigments	657	--	546	33	1,236
Catalysts	1,952	--	W	--	1,952
Other	83	4	8	1,190	1,285
Miscellaneous and unspecified	284	173	562	446	1,465
Total	43,612	11,654	1,116	7,094	63,476
Consumer stocks Dec. 31	8,181	2,380	209	1,345	12,115

W Withheld to avoid disclosing individual company confidential data, included in "Miscellaneous and unspecified."

[1] Includes calcium molybdate.

[2] Includes purified molybdenum disulfide, molybdenite concentrate added directly to steel, molybdenum metal powder, molybdenum metal pellets, and other molybdenum materials.

[3] Includes magnetic and nonferrous alloys.

STOCKS

The industrial inventory of molybdenum in concentrate and products totaled 41.6 million pounds, 21% less than at yearend 1973. Molybdenum in stocks at mines and plants dropped dramatically, those at producer plants decreased 28%, but those at consumer plants increased 49% compared with 1973 figures.

PRICES

The year 1974 was noted for sharply rising prices on all molybdenum products. The price stability that characterized molybdenum products during the past 5 years ended in February when producers increased prices an average of 10%. Subsequently, three additional price increases were instituted during the year. Higher operating costs due to inflation accounted for the rising molybdenum prices.

At yearend, price increases for molybdenum again were announced on domestic sales made on or after January 1, 1975. The following tabulation shows prices published in the January 6, 1975 issue of Metals Week for molybdenum and related products per pound of contained molybdenum:

Climax concentrate	$2.43
Byproduct concentrate	2.00–2.36
Climax oxide/cans	2.69
K-1 oxide/cans	2.69
K-2 oxide/cans	2.62
Ferromolybdenum/Climax lump	3.25
Ferromolybdenum/Climax powder	3.19

FOREIGN TRADE

Exports.—Exports of molybdenum in sulfide and oxide totaling 78.7 million pounds exceeded those shipped during the previous record year of 1973. Foreign markets received about 70% of the U.S. output compared with 64% in 1973. The Netherlands again was the principal destination, receiving 45% of the total. Most of the material entering the Netherlands was reshipped to other European countries, including those countries with controlled market economies. The new record high in exports was due to increased world demand and relatively low prices on foreign markets caused by the devalued and downward floating dollar.

Ferromolybdenum valued at $7.1 million was exported to 21 countries; Japan received 55% of the total value of shipments. Exports rose dramatically compared with 1973.

Other molybdenum products exported included metal and alloy in crude form, wire, powder, and semifabricated forms. Total value of these export products was nearly $6.9 million compared with $5.2 million in 1973. Metal and alloys (including scrap) totaling 104,935 pounds was shipped to 12 countries. The Republic of South Africa and West Germany received 59% of the exports. Molybdenum wire totaling 415,480 pounds was shipped to 34 countries. West Germany, Canada, France, Brazil, Israel, and Japan received 300,712 pounds, or over 72% of the total exported. Molybdenum powder exports of 202,785 pounds was shipped to 16 countries; Japan, the Netherlands, and Sweden received 86% of the total. Exports of semifabricated forms, n.e.c., totaled 251,088 pounds and were shipped to 24 countries. Five countries—the United Kingdom, Australia, West Germany, Canada, and the Netherlands—received nearly 73% of these exports.

Table 6.—Molybdenum reported by producers as shipments for export from the United States

(Thousand pounds contained molybdenum)

Product	1973	1974
Molybdenite concentrate	48,529	39,965
Molybdic oxide	38,471	35,949
All other primary products	2,851	2,921

Table 7.—U.S. exports of molybdenum ore and concentrates (including roasted concentrates), by country

(Thousand pounds contained molybdenum and thousand dollars)

Country	1973		1974	
	Quantity	Value	Quantity	Value
Argentina	36	70	40	96
Australia	354	531	425	797
Belgium-Luxembourg	6,017	9,799	10,389	19,202
Brazil	947	1,621	1,089	2,188
Canada	1,364	2,205	2,230	4,233
France	1,585	2,533	468	723
Germany:				
East	162	236	--	--
West	8,892	12,517	7,783	14,792
India	136	150	106	195
Italy	950	1,606	--	--
Japan	13,113	22,264	13,380	26,303
Mexico	690	939	883	1,297
Netherlands	29,888	50,754	35,103	69,764
New Zealand	15	22	18	41
Philippines	11	17	242	486
South Africa, Republic of	190	317	461	798
Spain	45	87	247	565
Sweden	4,611	6,849	2,511	3,777
Switzerland	584	630	56	115
United Kingdom	4,207	6,948	2,814	5,070
Venezuela	149	269	396	600
Other	12	23	19	33
Total	73,958	120,387	78,660	151,075

Table 8.—U.S. exports of molybdenum products

(Thousand pounds, gross weight, and thousand dollars)

Product and country	1973		1974	
	Quantity	Value	Quantity	Value
Ferromolybdenum:[1]				
Argentina	126	165	132	216
Australia	116	155	644	1,044
Brazil	70	97	32	41
Canada	220	309	589	975
Colombia	5	7	31	44
Germany, West	--	--	93	160
India	--	--	185	352
Japan	1,356	1,920	2,117	3,876
Mexico	--	--	10	23
Netherlands	13	26	--	--
Pakistan	--	--	11	16
Peru	4	6	21	34
South Africa, Republic of	125	195	177	237
Spain	3	6	43	61
Sweden	88	110	--	--
Taiwan	7	9	4	6
Thailand	82	131	--	--
Other	9	15	5	9
Total	2,224	3,151	4,094	7,094
Metal and alloys in crude form and scrap:				
Argentina	--	--	3	12
Belgium-Luxembourg	--	--	7	54
France	1	5	5	17
Germany, West	6	3	23	40
Japan	131	192	17	34
South Africa, Republic of	4	27	39	70
United Kingdom	2	11	(2)	1
Other	4	14	11	28
Total	148	252	105	256
Wire:				
Argentina	4	28	6	72
Australia	10	62	13	96
Belgium-Luxembourg	17	103	29	177
Brazil	21	239	39	409

See footnotes at end of table.

Table 8.—U.S. exports of molybdenum products—Continued

(Thousand pounds, gross weight, and thousand dollars)

Product and country	1973		1974	
	Quantity	Value	Quantity	Value
Wire—Continued:				
Canada	48	418	43	494
Finland	(2)	10	1	15
France	70	479	42	388
Germany, West	72	525	112	848
India	1	5	(2)	21
Israel	(2)	1	83	211
Italy	8	55	6	56
Japan	52	362	81	257
Mexico	7	161	4	86
Netherlands	5	160	18	478
Philippines	1	34	1	34
Singapore	(2)	7	(2)	13
Spain	22	158	14	97
United Kingdom	15	269	17	370
Other	4	34	11	138
Total	357	3,105	415	4,210
Powder:				
Argentina	--	--	9	38
Canada	10	33	2	7
France	3	11	--	--
Germany, West	3	11	1	7
Italy	(2)	1	--	--
Japan	125	428	78	241
Netherlands	3	11	61	242
Spain	5	9	(2)	1
Sweden	41	145	36	153
Switzerland	1	3	(2)	1
United Kingdom	2	7	11	18
Other	2	13	5	20
Total	195	672	203	728
Semifabricated forms, n.e.c.:				
Australia	4	30	33	89
Belgium-Luxembourg	3	22	3	28
Brazil	6	46	6	36
Canada	22	158	19	130
France	4	102	7	125
Germany, West	4	37	24	144
Guatemala	2	12	4	29
India	(2)	1	6	46
Italy	4	31	5	73
Japan	38	191	14	167
Korea, Republic of	(2)	2	1	47
Mexico	1	18	3	33
Netherlands	69	264	15	174
South Africa, Republic of	(2)	15	14	109
Sweden	16	84	(2)	5
Taiwan	2	15	1	15
United Kingdom	23	159	93	379
Other	11	34	3	41
Total	209	1,216	251	1,670

[1] Ferromolybdenum contains about 60% to 65% molybdenum.
[2] Less than ½ unit.

Imports.—According to the U.S. Department of Commerce, molybdenum products imported during 1974 included concentrate, metal, and chemicals. Total value of these products was reported at $2.6 million. A small quantity of concentrate containing 144,124 pounds of molybdenum was imported from Mexico and Canada. Seven countries exported metal products containing 229,692 pounds of molybdenum to the United States. Canada and the Netherlands were the source of about 61% of the shipments. Molybdenum chemicals entering the United States included ammonium molybdate, inorganic compounds, other molybdenum compounds, and molybdenum orange pigment. Two countries, the Netherlands and West Germany, shipped ammonium molybdate containing 169,483 pounds of molybdenum to the United States. The Netherlands supplied most of the material. A small quantity of inorganic compounds containing 3,872 pounds of molybdenum came from Italy. Imports of other molybdenum compounds totaling 129,797 pounds came from five countries; Chile and the Netherlands supplied over 60% of the total imports. The United States imported molybdenum orange from three countries—Canada Japan, and Mexico.

Table 9.—U.S. import duties

Item	Articles	Rate of duty, Jan. 1, 1975 [1]
601.33	Molybdenum ore	12 cents per pound on molybdenum content.
603.40	Material in chief value molybdenum	10 cents per pound on molybdenum content plus 3% ad valorem.
607.40	Ferromolybdenum	10 cents per pound on molybdenum content plus 3% ad valorem.
	Molybdenum:	
628.70	Waste and scrap	10.5% ad valorem.[2]
628.72	Unwrought	10 cents per pound on molybdenum content plus 3% ad valorem.
628.74	Wrought	12.5% ad valorem.
	Molybdenum chemicals:	
417.28	Ammonium molybdate	10 cents per pound on molybdenum content plus 3% ad valorem.
418.26	Calcium molybdate	Do.
419.60	Molybdenum compounds	Do.
420.22	Potassium molybdate	Do.
421.10	Sodium molybdate	Do.
423.88	Mixtures of inorganic compounds, chief value molybdenum	Do.
473.18	Molybdenum orange	5% ad valorem.

[1] Not applicable to Communist countries.
[2] Duty on waste and scrap temporarily suspended.

WORLD REVIEW

World molybdenum production increased about 4.2 million pounds compared with that of 1973. About one-half of production was from byproduct sources, principally copper. Lower demand for copper due to depressed world economic conditions resulted in a decrease in output of byproduct molybdenum. Two countries, the United States and Canada, accounted for about 75% of molybdenum output. No official statistics are available on molybdenum production in Australia, Bulgaria, People's Republic of China, and the U.S.S.R., but estimates for these countries were included in the worlds total in table 10.

Table 10.—Molybdenum: World mine production by country
(Thousand pounds contained molybdenum)

Country [1]	1972	1973	1974 [p]
Australia	[r] 9	[e] [r] 2	[e] 25
Bulgaria [e]	310	310	310
Canada (shipments)	[r] 28,493	30,391	29,603
Chile	13,045	12,974	21,510
China, Peoples Republic of [e]	3,300	3,300	3,300
Japan	494	345	235
Korea, Republic of	111	112	[e] 140
Mexico	172	90	[e] 90
Norway	[r] 562	448	--
Peru	[r] 1,689	1,591	[e] 1,650
U.S.S.R. [e]	18,100	18,700	19,400
United States	112,138	115,859	112,011
Total	[r] 178,423	184,122	188,274

[e] Estimate. [p] Preliminary. [r] Revised.
[1] In addition to the countries listed, Argentina, North Korea, Nigeria, Romania, Territory of South West Africa, and Spain also produce molybdenum, but information is inadequate to make reliable estimates of output levels.

Australia.—A rich, pipe-type mineralization containing principally molybdenum and other associated minerals was reportedly discovered near Rocky River, 35 miles south of Tenterfield, State of New South Wales. The prospect, located at a depth of 70 feet, was being drilled to determine the extent of mineralization.

Argentina.—Cia. Minera Aquilar S.A., subsidiary of St. Joe Mineral Corp., conducted additional exploratory drilling on the Pachou porphyry copper deposit which also contains molybdenum. Ore reserves were revised upward to 550 million tons from the 270 million tons reported in 1973. The grade of the ore was reported to average 0.65% copper and 0.015% molybdenite. Exploration of the deposit and metallurgical testing of the ore was continued to develop necessary data for a feasibility study of the deposit. Some high-grade copper mineralization exists near the surface, hence the deposit is amenable to open pit mining methods.

Canada.—Molybdenum production declined 788,000 pounds in 1974 and was 2.6% lower than in 1973. Reduced production at byproduct plants and labor problems at the Endako mine, the nations largest primary producer, was responsible for lower molybdenum output. Despite a drop in production, Canada remained in second place among producers of molybdenum and supplied 16% of world output.

Although Canadian consumption increased substantially over the past years, the industry remained dependent on export markets to maintain a viable molybdenum mining industry. Exports rose from 24.6 million to 27.4 million pounds in 1974, an increase of over 11% compared with those of 1973. Japan, Belgium, and Luxembourg received about 70% of the molybdenum shipments.

A strike was instituted at the Endako mine of Canex Placer Ltd. on October 11, 1974, by the Canadian Association of Industrial Mechanical and Allied Workers Union. Consequently, on October 17 the company declared a force majeure on deliveries of molybdenite concentrate, molybdic oxides, and ferromolybdenum. The workers returned to work in mid-December when the dispute was settled.

Exploration of potentially minable deposits of molybdenum continued in Canada, particularly in the Western Provinces. Improvement in world molybdenum demand resulted in reopening of a mine, and increasing throughput at concentrators processing primary ores.

Casino Silver Mines Ltd. reportedly drilled an ore deposit totaling 180 million tons having an average grade of 0.37% copper and 0.04% molybdenite. The Casino property, located nearly 200 miles northwest of Whitehorse, Yukon Territory, is amenable to open pit mining and has a waste-to-ore stripping ratio of 1.7 to 1. The ore also contained an undisclosed amount of gold and silver which can be economically recovered. Plans for development of the deposit were not announced.

Brynnor Mines Ltd., subsidiary of Noranda Mines Ltd., reopened the Boss Mountain mine because of an increasing demand for molybdenum. The mine had been shutdown since December 3, 1971. Mine production for its last year of operations amounted to 334,500 tons of molybdenite ore. At yearend, 1971, ore reserves were reported at 2.7 million tons averaging 0.4% molybdenite. A 1,000-ton-per-day concentrator was maintained in operating condition during the shutdown.

Western Mines Ltd. negotiated an agreement with Granite Mountain Mines Ltd. to prepare a feasibility study and conduct additional exploration drilling and testing on a copper-molybdenum deposit near Powell River in British Columbia. The deposit reportedly contains an estimated 90 million tons of ore having an average grade of 0.32% copper and 0.02% molybdenite.

The Granby Mining Co. Ltd. renewed its option on the Carmi molybdenum deposit near Kelowna, British Columbia, owned by Vestors Exploration Ltd. Drilling to date reportedly outlined molybdenum mineralization estimated at 29 million tons of ore having an average grade of 0.22% molybdenite. The company will drill an additional 25 holes and conduct other investigative work costing an estimated $1 million. The property comprises a block of 176 mineral claims. Previous drilling by the owner resulted in discovery of an impressive molybdenum deposit amenable to open pit mining.

Japan.—Mitsubishi International Corp. was designated as the exclusive sales agent in Japan for molybdenum and rare-earth mineral products manufactured by Molycorp. The agreement would be effective on January 1, 1975. In return for the sales agency, Mitsubishi International Corp. would purchase $5 million worth of subordinated notes convertible into Molycorp's common stock.

Mexico.—Lytton Minerals Ltd. acquired interest in the La Verde copper-molybdenum deposit in Michoacán State. Additional exploratory drilling, metallurgical testing of the ore, and a feasibility study was completed on the mineral deposit. A viable mining operation processing 16,500 tons of ore per day was ascertained by the study. Reserves were calculated totaling over 87 million tons of ore averaging 0.7% copper and 0.02% molybdenite.

Mexicana de Cobre S.A. obtained additional financing from a consortium of International banking institutions to develop the La Caridad copper-molybdenum deposit near Nacozari in Sonora State. Construction of an open pit mine, mill, smelter, and refining complex was estimated to cost over $300 million. Reserves were estimated at 700 million tons of ore having an average grade of 0.76% copper and 0.016% molybdenite. The concentrator will process ore at a rate of 60,000 tons per day. Parsons-Jurden Co., a Division of Ralph M. Parsons Co., was the contractor. Work projects underway included construction of an air strip and a 50-mile road from Nacozari to the mine site.

Mongolia.—A legend describing a mysterious cauldron of copper hidden beneath the Erdenetyin Ovo (Treasure Hills) was reportedly responsible for discovery of a vast copper-molybdenum ore body in Mongolia. The deposit, located about 200 miles northwest of Ulan Bator, in the remote mountain ranges along the Soviet-Mongolian border, was being developed as an open pit mine.

Numerous expeditions were conducted into the remote area in search of the copper cauldron and to prospect for other minerals, but results proved disappointing. In the late 1960's, a team of Mongolian and Czechoslovakian geologists conducted an intensive petrographic study of the igneous rocks in the area and subsequently made the initial discovery of copper and molybdenum mineralization. Development currently underway lends credence to the legend.

It was apparent that the remoteness of the deposit would necessitate huge expenditures for construction of a mineral plant, connecting railroad, and electric power transmission lines to Erdenet. In 1973, the Mongolian Government negotiated a joint venture agreement with the U.S.S.R. to develop the deposit. The Soviets would provide most of the funds and technological assistance in return for future production of copper and molybdenum. The mine reportedly will produce at a rate of 16 million tons of ore per year. Production was scheduled to start in 1978. A concentrator, warehouse, other ancillary facilities, and townsite were in various stages of construction.

Netherlands.—AMAX, Inc., planned to increase capacity to 30 million pounds at its molybdenum conversion plant near Rotterdam. The expansion, costing $15 million, included installation of an additional roaster, construction of a sulfuric acid plant, and building of warehouses and other ancillary facilities. The increase in capacity was required to meet anticipated rising demands for molybdenum products in Europe. Completion of the facility was scheduled for 1975.

Peru.—Empresa Minera del Peru (Mineroperu) initiated development of the Toromocho copper-molybdenum deposit located about 120 miles east of Lima. The project, costing an estimated $730 million, will include additional drilling and testing of the ore deposit, removal of over 14 million tons of overburden, and construction of a mine-mill smelter-refining complex. The mineral complex was expected to produce yearly over 80,000 tons of copper metal and about 4 million pounds of molybdenum. Completion of the entire project was scheduled for 1981. The Government of Peru acquired the deposit from Cerro de Pasco Corp. in 1973 and assigned it to Mineroperu for development.

TECHNOLOGY

Industrial and institutional research in 1974 was conducted to discover new uses for molybdenum. Researchers studying industrial applications for molybdenum investigated its use in corrosion, high temperature, nuclear, and electronic applications. Scientists also explored many other fields of essential molybdenum research, such as, extractive, and physical metallurgy of the metal and alloys.

The Bureau of Mines produced molybdenum alloys with good strength properties at elevated temperatures by the powder metallurgical internal oxidation method.[2] Molybdenum was blended with reactive powder of 0% to 10% zirconium-molybdenum ($ZrMo_2$). The effects of composition, blending procedure, and sintering conditions on strength properties at elevated temperatures were evaluated in the report. Strengthening was attributed to zirconium in solid solution with molybdenum and to the presence of submicrometer particles of ZrO_2.

A process for the preparation of molybdenum metal by electrolysis of molybdenum carbide in a molten salt electrolyte was described.[3] An optimum metal recovery rate was obtained in an inert atmosphere electrolytic cell utilizing a KCL-K_3 $MoCl_6$ electrolyte. The process yielded a total metal recovery of 71% at an average current efficiency of 60%. The metal purity exceeded 99.9% and the hardness was in the range of 150 to 160 diamond pyramid hardness (DPH). This experiment demonstrated the feasibility of electron extraction of molybdenum from its carbide. The electrolyte proved superior to others for sustained electro-extraction.

The hot corrosion behavior of a series of wrought nickel-base superalloy specimens was investigated as a function of molybdenum content ranging from 0 to 8 weight percent and the results were published.[4] The specimens were heated in a burner rig containing a solution with 5-part-per-million salt concentration. Molybdenum significantly reduced the amount of hot corrosive attack at 1,600° F on some nickel- base alloys containing chromium and aluminum. Molybdenum had little effect at 1,800° F on corrosion resistance on the specimens except those containing 6% aluminum. Sulfidation attack at 1,600° F was greater than at 1,800° F on nickel-base alloys containing chromium and aluminum. The sulfidation attack was greater at 1,800° F on nickel-base alloys containing chromium, aluminum, and titanium.

The effect of dextrin on molybdenum surface properties was investigated experimentally by measuring the Zeta potential, absorption, densities, contact angles, Hallimond tube flotation, and oil flotation.[5] It was ascertained that the absorption of dextrin on molybdenum is independent of pH and follows a Langmuir-type of behavior. It appears to result from hydrophobic bonding, with the polymer molecule displacing the water molecule at the interface. The Zeta potential of molybdenite was reduced in absolute magnitude with dextrin due to movements of the slipping plane farther out into the solution by the absorption of large nonionic polymer molecules. Dextrin was a very effective depressant for the air flotation of molybdenite in the absence of a collector, whereas, it does not effectively depress molybdenite in an oil flotation process using iso-octane. This must result from the complex contribution of electrical double layer repulsion, van der Waal's attraction, and hydration effects, together with possible partial solubility of dextrin in the oil phase or with displacement of absorbed dextrin by the oil phase.

Molybdenum metal was produced from molybdenum disulfide by two different extraction processes and the results were published.[6] One process utilized two steps consisting of (1) aluminothermic reduction of molybdenum disulfide and (2) conversion of this disulfide to high-purity molybdenum metal by fused-salt electrorefining. Another process utilized a direct recovery of molybdenum from molybdenum disulfide-carbon anodes by fused-salt electrorefining. In the electrorefining of thermit metal, a metal recovery of 85% and an average current efficiency of 70% was obtained. Electrolysis of molybdenum disulfide-carbon anodes resulted in a metal recovery of 82% at an average current efficiency of 50%. Both extraction processes yielded molybdenum of comparable purity.

Several types of molybdenum organic-inorganic corrosion inhibitors were tested and the results were reported.[7] In view of increasing water pollution restrictions, new chemical compound corrosion inhibitors were designed to provide effective control on the quality of industrial effluents. Molybdenum corrosion inhibitors facilitated anodic passivation, and the transition between active and passive potentials comprised several well-defined states which were registered in potentiostatic measurements. Molybdates have an advantage over traditional inhibitors because they are nontoxic. Some molybdate salts in diluted solutions inhibit corrosion as efficiently as chromate and nitrite salts.

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[2] O'Brien, W. L., and R. Blickensderfer. Strengthening Molybdenum by Powder Metallurgical Internal Oxidation of $ZrMo_2$, BuMines RI 7958, 1974, 14 pp.

[3] Suri, A. K., D. K. Bose, and C. K. Gupta. Electro-Extraction of Molybdenum From Mo_2C—Type Carbide, Met. Trans., v. 5, No. 2, February 1974, pp. 451–455.

[4] Morrow, H., D. L. Sponseller, and E. Kalns. The Effects of Molybdenum and Aluminum on the Hot Corrosion (Sulfidation) Behavior of Experimental Nickel-Base Superalloys, Met. Trans., v. 5, No. 3, March 1974, pp. 673–683.

[5] Wie, J. M., and D. W. Fuerstenau. The Effect of Dextrin on Surface Properties and the Flotation of Molybdenite, Internat. J. of Miner. Processing, v. 1, No. 1, March 1974, pp. 17–32.

[6] Mukhryee, T. K., and C. K. Gupta. Molybdenum Extraction From Molysulfides. Met. Trans., v. 5, No. 3, March 1974, pp. 707–713.

Physical properties of newly developed corrosion resistance stainless steel containing molybdenum were published.[8] The report reviews some of the recent developments in molybdenum-containing stainless steels and alloys. Other steels discussed were ferritic, austenitic, austenitic-ferritic stainless steels, and other higher alloy materials. Recent progress in developing nickel-molybdenum and nickel-chromium-molybdenum alloys also was evaluated. Molybdenum improves the corrosion resistance of both stainless steels and nickel-base alloys, especially under reducing conditions and in the presence of chlorides. The new ferritic stainless steel was expected to solve stress-corrosion cracking problems under many plant environments.

Among the patents issued were several, concerning beneficiation, roasting, refining, and leaching. Patents granted were for froth flotation of copper sulfide ores which contain molybdenite and other sulfide minerals;[9] for recovery of volatized rhenium from molybdenite roaster gases;[10] for froth flotation recovery of molybdenite from copper sulfide ore using xanthate as a depressant;[11] for lowering the lead impurity content of molybdenum concentrate;[12] for extraction of molybdenum and rhenium from molybdenite containing ore with an ammonium persulfate solution;[13] for refining of molybdenite by roasting then subsequent leaching;[14] for upgrading of low-grade molybdenite containing a nonsulfide gangue by roasting and the calcine leach method;[15] for prevention of foaming in the cleaner step of the froth flotation of molybdenum;[16] for solvent extraction recovery of molybdenum, rhenium, and selenium from acqueous off-gas scrubber in molybdenite roasting;[17] for recovery of molybdenum trioxide ores containing molybdenum disulfide;[18] for electrowinning molybdenum and rhenium from a slurry of finely divided ore;[19] for recovering molybdenum and rhenium from amine or quaternary ammonium extractant;[20] for recovery of molybdenum from an alkali solution;[21] for recovery of molybdenum in a three-chambered electrolytic cell;[22] and for leaching molybdenum concentrate of solubilized lead.[23]

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[7] Koeppen, A., G. S. Emerle, K. Nishio, and B. A. Metz. Pollution Control Technology Applied to Cooling Water Treatment. Nat. Assoc. of Corrosion Engineers, v. 13, No. 7, July 1974, pp. 23–28.

[8] Steigerwald, R. F. New Molybdenum Stainless Steels for Corrosion Resistance: A Review of Recent Developments. Materials Performance, v. 13, No. 9, September 1974, pp. 9–16.

[9] Werneke, M.F. (assigned to American Cyanamid Co.) Froth Flotation and Beneficiation. U.S. Pat. 3,785,488, Jan. 15, 1974.

[10] Platzke, R.N., and H. R. Spedden (assigned to Kennecott Copper Corp.). Recovery of Volatized Rhenium. U.S. Pat. 3,783,158, Jan. 1, 1974.

[11] Werncke, M.F. (assigned to American Cyanamid Co.). Froth Flotation. U.S. (Pat. 3,788,467, Jan. 29, 1974.

[12] Lane, M. (assigned to Kennecott Copper Corp.). Method of Lowering the Lead Impurity Content in Molybdenum Concentrate. Canadian Pat. 944,958, Apr. 9, 1974.

[13] Carlin, W. W. (assigned to Pittsburg Plate Glass Industries, Inc.). Extraction of Molybdenum and Rhenium. U.S. Pat. 3,816,588, June 11, 1974.

[14] Ronzio, R. A., J. W. Lane, and J. D. Vincent (assigned to American Metal Climax, Inc.) Refining of Molybdenite. U.S. Pat. 3,829,550, Aug. 13, 1974.

[15] Queneau, P. B., and J. D. Prater (assigned to Kennecott Copper Corp.). Upgrading of Low-Grade Molybdenite. U.S. Pat. 3,834,893, Sept. 10, 1974.

[16] Michalski. R. J., and J. T. Cantwell (assigned to Nalco Chemical Co.). Prevention of Foaming in Cleaner Flotation. U.S. Pat. 3,837,489, Sept. 24, 1974.

[17] Platzke, R. N. (assigned to Kennecott Copper Corp.). Solvent Extraction Recovery of Molybdenum, Rhenium, and Selenium. U.S. Pat. 3,848,069, Nov. 12, 1974.

[18] Ronzio, R. A., H. Kay, and J. D. Vincent (assigned to American Metal Climax, Inc.). Recovery of Molybdenum Values From Molybdenite. U.S. Pat. 3,848,049, Nov. 12, 1974.

[19] Schreiner, B. J., R. E. Lindstrom, and T. A. Henrie (assigned to U.S. Secretary of the Interior). Extraction of Molybdenum and Rhenium Values From Molybdenite Ores. U.S. Pat. 3,849,265, Nov. 19, 1974.

[20] Drobnick, J. E., E. W. Dougherty, and A. E. Erhard. (assigned to Molybdenum Corporation of America). Extraction of Molybdenum and Rhenium Values From Molybdenite. Canadian Pat. 958,224 Nov. 26, 1974.

[21] Ammann, P. R., J. H. Kim, and M. J. Redman (assigned to Kennecott Copper Corp.). Recovery of Molybdenum From a Reverberatory Smelting Slag. U.S. Pat. 3,857,699, Dec. 31, 1974.

[22] Rothmann, H., and W. Kell (assigned to Gesellschaft fur Elektrometallurgie m.b. H). Production of a Hydroxide of Molybdenum From an Aqueous Alkali Ore Leach Solution. U.S. Pat. 3,856,641, Dec. 24, 1974.

[23] Kentro, D. M. (assigned to Molybdenum Corporation of America). Method for Removing Lead Impurity From Molybdenite Concentrate. U.S. Pat. 3,854,930, Dec. 17, 1974.

Natural Gas

By Gordon W. Koelling [1] and Leonard L. Fanelli [2]

Marketed production of natural gas in the United States declined approximately 1.0 trillion cubic feet (Tcf) to 21.6 Tcf in 1974. This 4.6% decrease, the first since 1938, followed the rapid depletion of the Nation's proved natural gas reserves during the recent years.

Total consumption of natural gas (including extraction losses) in 1974 was 22.1 Tcf, 3.7% less than during 1973. All categories of consumption registered declines during 1974. The industrial sector, the dominant user of natural gas, experienced the greatest decline, 438 billion cubic feet (Bcf), and the electric utilities and residential sectors registered decreases of 176 Bcf and 93 Bcf, respectively. Declining consumption in the industrial and electric utility sectors during 1974 was related to a 6.9% increase in the curtailment of firm deliveries by pipeline companies, and to a general decline in the Nation's economic activity. A warmer than normal winter and conservation efforts contributed to the decrease in residential use.

Table 1.—Salient statistics of natural gas in the United States

	1970	1971	1972	1973	1974
Supply:					
Marketed production [1] million cubic feet	21,920,642	22,493,012	22,531,698	22,647,549	21,600,522
Withdrawn from storage do	1,458,607	1,507,630	1,757,218	1,532,820	1,700,546
Imports do	820,780	984,548	1,019,496	1,032,901	959,284
Total do	24,200,029	24,985,190	25,308,412	25,213,270	24,260,352
Disposition:					
Consumption do	22,045,799	22,676,581	23,009,445	22,965,914	22,110,623
Exports do	69,813	80,212	78,013	77,169	76,789
Stored do	1,856,767	1,839,398	1,892,952	1,974,324	1,784,209
Lost in transmission, etc do	227,650	388,999	328,002	195,863	288,731
Total do	24,200,029	24,985,190	25,308,412	25,213,270	24,260,352
Value at wellhead:					
Total thousand dollars	3,745,680	4,085,482	4,180,462	4,894,072	6,573,402
Average cents per thousand cubic feet	17.1	18.2	18.6	21.6	30.4

[1] Marketed production of natural gas represents gross withdrawals less gas used for repressuring and quantities vented and flared.

Exports of 77 Bcf in 1974 were almost the same as in 1973. Approximately 65% of total 1974 exports were shipped from Alaska to Japan as liquefied natural gas (LNG). The remaining exports, which were transported by pipeline, were almost equally divided between Canada and Mexico.

Natural gas imports declined 7.1% to 959 Bcf in 1974. Essentially, all of this gas was shipped from Canada via pipeline. Imports from Mexico were insignificant and no LNG shipments were received.

Proved reserves of natural gas declined 5.2% from 250.0 Tcf at yearend 1973 to 237.1 Tcf by yearend 1974 as annual discoveries failed to equal production for the sixth time in the last 7 years. New reservoir discoveries in old fields and new field discoveries during 1974 totaled 4.2 Tcf, and extensions to known fields accounted for 5.8 Tcf. Revisions of previous reserve estimates resulted in a net reduction of 1.3 Tcf.

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[1] Mineral specialist, Division of Petroleum and Natural Gas.

[2] Survey statistician, Division of Fuels Data.

The average wellhead value of natural gas increased 40.7% to 30.4 cents per thousand cubic feet (Mcf) in 1974. During the same year, the average retail price for gas delivered to consumers rose 22.3% to 89.4 cents per Mcf.

Efforts to supplement natural gas supplies through the gasification of liquid fuels continued. Eleven such synthetic gas plants were operational, and three were planned as of yearend 1974.

Five pilot projects for the development and testing of processes for the production of high-Btu gas from coal were operational or under construction at yearend 1974. A Bureau of Mines experimental coalbed degasification project was also in progress during the year. Several gasification projects involving biomass conversion were also under development.

Research involving fracturing techniques to stimulate flow from economically submarginal gas reservoirs was also in progress.

The Federal Power Commission (FPC), which regulates the sale, transportation, and price of gas moved in interstate commerce, established a single uniform national base rate for interstate natural gas sales by producers in an opinion issued June 12, 1974. This rate applies to gas from wells commenced since January 1, 1973, and to new dedications of gas to interstate commerce since that date. The base rate of 42 cents per Mcf established by the June 12 opinion was raised to 50 cents per Mcf on December 4, 1974.

The Office of Pipeline Safety (OPS), which is responsible for safety regulation of natural gas pipelines, reported that the total number of pipeline failures increased 8.3% during 1974. Damage by outside forces was the cause of 69.7% of total failures. Data on pipeline failures are shown in table 2.

Federal gas pipeline safety standards contained in the Code of Federal Regulations (CFR) 49, Part 192, were amended in 1974 to extend the period for continuing odorization of gas in certain transmission lines until January 1, 1977. Notices were also issued proposing to amend the standards with regard to qualifications for use of plastic pipe, improved requirements for pipe welding and weld inspections, telemetering pressures to provide advance warnings of pipeline failures, new standards for offshore lines, and a clearer definition of gathering lines.

DOMESTIC PRODUCTION

Gross withdrawals of natural gas, including marketed production, gas returned to the formation for pressure maintenance and that vented or flared, totaled 22.8 Tcf in 1974, approximately 5.1% less than 1973. Marketed production declined 4.6% to 21.6 Tcf during 1974, and the quantity of gas used for repressuring decreased 7.8% to about 1.1 Tcf. Data on gross withdrawals and disposition of natural gas appear in table 4.

Gross withdrawals from gas wells declined 3.6% in 1974 to 18.7 Tcf, and gas withdrawals from oil wells dropped 11.0%. Increased gross withdrawals were registered by 15 of the 31 producing States ,but the quantities involved were small. The largest gain, 30.7 Bcf, was in New Mexico, the only major producing State to record an increase.

The combined decrease in gross withdrawals registered by the three largest producing States; Texas, Louisiana, and Oklahoma; was equivalent to approximately 93% of the country's total net decline in 1974. Oklahoma registered a decline of 7.0%, most of which was accounted for by decreased gas withdrawals from oil wells. Louisiana showed a decline of 6.7%, over one-half of which was accounted for by a drop in production from gas wells, and Texas registered a decrease of 4.6%, most of which was accounted for by a decline in gas well production.

Almost three-fourths of total 1974 marketed natural gas production was from Texas and Louisiana. Marketed production data for the leading producing States are shown in the following tabulation:

State	1974 marketed production (Bcf)	Percent of change from 1973	Percent of total U.S. marketed production in 1974
Texas	8,171	−4.0	37.8
Louisiana	7,754	−5.9	35.9
Oklahoma	1,639	−7.5	7.6
New Mexico	1,245	+2.1	5.8
Kansas	887	−.1	4.1
California	365	−18.7	1.7
Wyoming	327	−3.7	1.5
Others	1,213	+.9	5.6
Total	21,601	4.6	100.0

Gas well completions increased 14.3% to 7,239 in 1974. Approximately 40.7% of the total net increase in gas well completions was accounted for by Texas where development of the Laredo field was partially responsible for increased activity. Another 12.2% of the total increase was registered by Ohio where most of the wells completed were relatively shallow. A summary of gas and oil well completions appears in table 5.

Completions of exploratory gas wells in 1974 increased 32.7% to 1,194, as shown in table 6. Texas accounted for 47.1% of these completions.

Data on gas well completions include condensate wells. The latter are wells which produce from high-pressure natural gas reservoirs, some of which contain considerable quantities of liquid hydrocarbons in the pentanes and heavier range described generically as "condensate."

The number of gas and gas condensate wells producing at yearend 1974 totaled 126,329. This was an increase of 1.7% over the 1973 yearend total, but was 12.6% less than the number of wells producing at yearend 1969.

CONSUMPTION AND USES

Consumption of natural gas (wet) in 1974 totaled 22.1 Tcf, a 3.7% decrease from 1973. Gas delivered to consumers declined 3.8% to 19.1 Tcf during 1974 when it accounted for 86.3% of total consumption. Of the remainder, 6.7% was used as lease and plant fuel, 3.0% was used for pipeline fuel, and 4.0% was accounted for by extraction losses (shrinkage) at gas processing plants. Data on total natural gas consumption and on deliveries to consumers, by type of consumer, are presented in tables 8-9.

Residential use declined 1.9% to 4,786 Bcf in 1974 when it accounted for 25.1% of total deliveries to consumers. The decrease in residential use, which was accompanied by a 2.1% increase in the number of consumers, reflected a warmer than normal winter season and the positive results of conservation efforts.

Data on the number of residential customers by Census Regions for the years 1964, 1973, and 1974 are shown in the following tabulation:

Census regions	Residential consumers (thousands)		
	1964	1973	1974
New England	1,491	1,603	1,623
Middle Atlantic	7,357	7,713	7,779
East North Central	7,813	9,386	9,439
West North Central	2,945	3,399	3,519
South Atlantic	2,835	3,513	3,569
East South Central	1,641	1,959	2,001
West South Central	3,919	4,575	4,811
Mountain	1,402	2,021	2,151
Pacific	5,172	6,476	6,617
Total	34,575	40,645	41,509

The use of gas by the commercial sector declined 1.1% to 2,263 Bcf in 1974 despite a 4.3% increase in the number of customers. This sector accounted for 11.9% of total deliveries to consumers.

The industrial sector remained the dominant user of natural gas, accounting for 43.5% of 1974 deliveries to consumers. However, total consumption by this sector declined 5.0% to 8,306 Bcf during the year. Most of the gas used by industry was consumed as fuel. Primary metal industries, which used an estimated 1,060 Bcf, and petroleum refineries, which used 1,040 Bcf, were the principal fuel consuming industrial sectors. Other important industrial users of gas for fuel included the nonmetallic, paper, and food products sectors. The principal nonfuel use of gas involved the chemicals industry which used it as a feedstock, primarily in the production of fertilizers and plastics. In 1974, an estimated 1,490 Bcf was used by the chemicals industry both as feedstock and for fuel.

Electric utility use of natural gas continued to decline in 1974 when consumption by this sector dropped 4.9% to 3,429 Bcf. The decrease was greatest in the Pacific region where consumption declined 164 Bcf. Consumption rose 95 Bcf in the West South Central region and small increases occurred in the New England and East North Central regions.

The decline in natural gas supply dur-

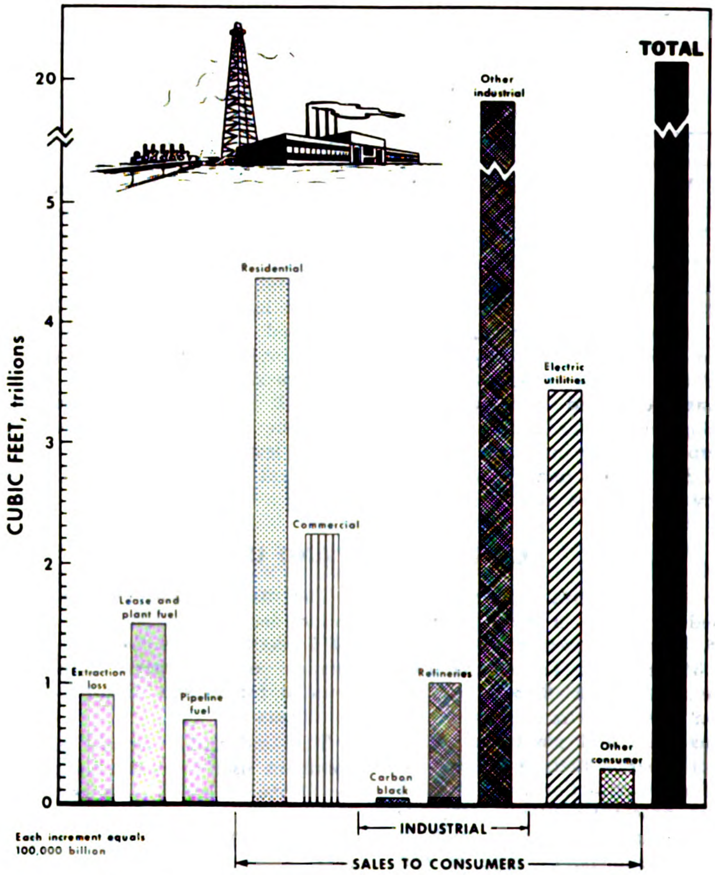


Figure 1.—Disposition of natural gas consumed in the United States by principal use.

ing 1974 forced many gas distribution companies to deny service to new customers and to curtail supplies to some existing users. FPC reported that net curtailments of actual firm net requirements for the year April 1974 through March 1975 totaled 2,013 Bcf, a deficiency of 13.6%. Net interruptible curtailments for the same period were reported at 196 Bcf, a deficiency of 36.6%. Firm curtailments for the year ending March 1974 were 6.9% higher than those for the preceding period and interruptible curtailments showed little change. Data on curtailments are shown in tables 11-12.

The mileage of field and gathering, transmission, and distribution pipelines in service at the end of 1974 was up 1.3% from 1973. Most of this increase was accounted for by a 1.8% increase in the mileage of gas distribution mains which reflected the expansion of the gas utility industry into less densely populated areas. Data on the nations natural gas pipeline network are shown in the following tabulation:

Mileage, natural gas pipelines

	1962	1972	1973	1974
Field and gathering	58.7	67.1	66.2	67.0
Transmission	196.4	r 258.5	263.6	263.5
Distribution	428.1	r 624.6	634.6	646.2
Total	683.2	r 950.2	964.4	976.7

r Revised.

RESERVES

Discoveries of natural gas failed to equal production during 6 of the last 7 years, and proved reserves declined 19% during the period. In 1974, the quantity of gas discovered was considerably less than that produced, and proved reserves dropped 5.1% from 250.0 Tcf at yearend 1973 to 237.1 Tcf by yearend 1974 according to the Natural Gas Reserves Committee of American Gas Association (AGA).

Additions to proved reserves reported for the United States in 1974 aggregated nearly 8.9 Tcf, approximately 37% more than in 1973. About 30% of net additions to reserves in 1974 were offshore in the Gulf of Mexico. The largest addition to reserves, 5.8 Tcf, involved extensions to known fields. More than 55% of the 2.2 Tcf total for new reservoir discoveries in old fields (including offshore) were in Louisiana. New field discoveries totaled approximately 2.0, over 71% of which was accounted for by Louisiana and Texas. On the negative side, revisions of previous reserve estimates resulted in a net reduction of 1.3 Tcf. Details on proved reserves of natural gas in the United States are shown in table 16.

There were some net increases during 1974 in the reserves of natural gas in 15 States. However, significant increases occurred in only three States; Alaska with 0.22 Tcf, Alabama with 0.18 Tcf, and Florida with 0.16 Tcf. Reserves of the principal gas-producing States declined sharply. Texas gas reserves declined 6.4 Tcf, or 7.5%, and reserves in Louisiana decreased 5.1 Tcf, or 7.4%.

Natural gas reserves committed to interstate pipelines declined in 1974 for the seventh consecutive year. Dedicated domestic reserves dropped 10.3% in 1974, and domestic gas produced and purchased by interstate pipelines declined 5.9% from the 1973 total of 13.7 Tcf to 12.9 Tcf in 1974. The reserve-production ratio for interstate reserves dropped from 9.8 at yearend 1973 to 9.3 by yearend 1974. Additional data are shown in the following tabulations:

Preliminary summary of domestic natural gas reserves, of interstate natural gas pipeline companies

(Billion cubic feet at 14.73 psia at 60° F)

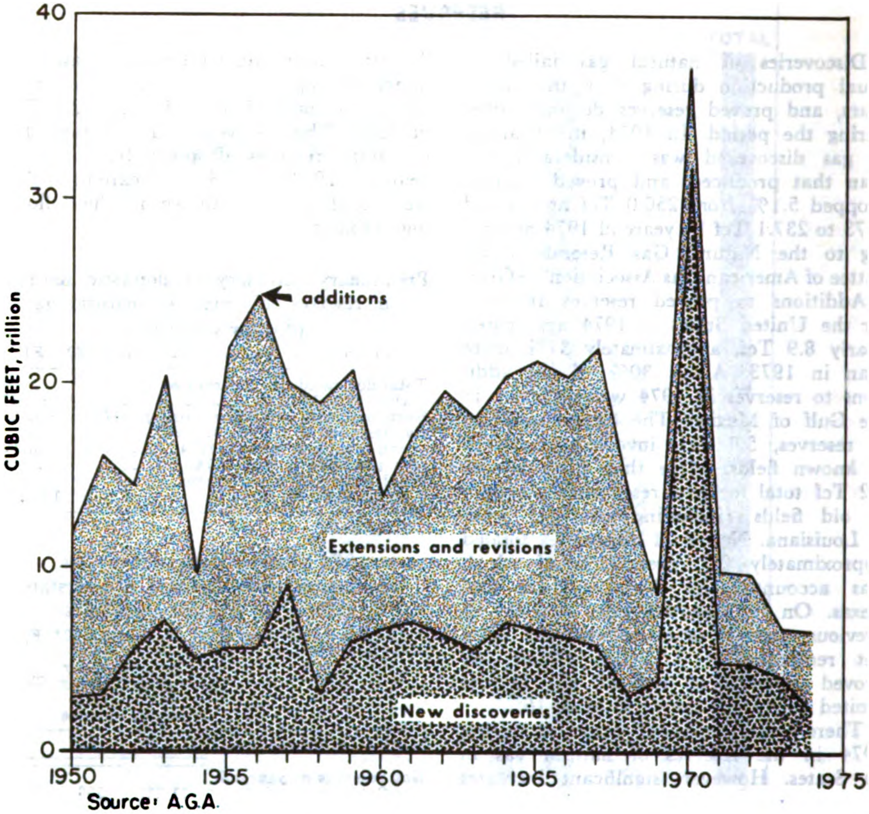
Total dedicated gas reserves as of Dec. 31, 1973	r 134,317
Revisions and additions during 1974	−1,008
Gas reserves as of Dec. 31, 1973 and changes during 1974	133,309
Gas produced during 1974	12,888
Total dedicated gas reserves as of Dec. 31, 1974	120,421

r Revised.

1974 Yearend domestic reserves, production, and purchases, of interstate natural gas pipeline companies

(Billion cubic feet at 14.73 psia at 60° F)

	Major supply companies	Minor supply companies	Total
Number of companies	26	35	61
Gas reserves at yearend:			
Company owned	11,231	590	11,821
Independent producer contracts	106,958	1,642	108,600
Total	118,189	2,232	120,421
Percent of total	98.1	1.9	100.0
Annual production and purchases:			
Company owned	714	58	772
Independent producer contracts	11,920	196	12,116
Total	12,634	254	12,888
Percent of total	98.0	2.0	100.0



Source: A.G.A.

Figure 2.—Trends in annual additions to natural gas reserves.

PRODUCTIVE CAPACITY

The daily productive capacity for natural gas in 1974 was estimated at 72,311 million cubic feet (MMcf) by AGA, compared with 78,231 MMcf in 1973, a decline of 7.6%. Nonassociated gas productive capacity fell 6.3% to 60,091 MMcf per day, and associated-dissolved gas productive capacity declined 13.2% to 12,220 MMcf per day in 1974.[3]

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[3] The productive capacity of natural gas from nonassociated reservoirs is defined as the maximum daily rate at which such gas can be produced from natural reservoirs under specified conditions on March 31 of any given year. The determination of productive capacity on March 31 of any given year is based on proved reserves of nonassociated gas reservoirs as of the preceding December 31. The productive capacity of associated dissolved gas is based on the productive capacity of crude oil and the estimated producing gas-oil ratios which would result from such capacity operation during the first 90 days of a given year. The productive capacity of associated gas from oil wells is usually based on the volumetric withdrawal of crude oil from related oil wells at capacity rates during the first 90 days of a given year as determined by the American Petroleum Institute (API) Committee on Reserves and Productive Capacity.

STORAGE

The development of additional underground storage capacity for natural gas continued during 1974. Total reservoir capacity increased 1.4%, from 6,279 Bcf in 1973 to 6,364 Bcf by yearend 1974. The number of underground storage facilities was increased from 360 in 1973 to 367 in 1974. These storage facilities are located in 26 States.

Most storage reservoirs are depleted gasfields. Of the total 367 storage reservoirs in use, 288 or 78% were of this type. Most of these reservoirs are located in the northeastern United States, primarily in the oldest oil and gas producing States. In Pennsylvania, where oil production dates back to 1859, nonassociated gasfields converted to storage facilities totaled 68 at yearend 1974. West Virginia had 35 reservoirs of this type as of the same date. The second largest concentration of these storage reservoirs was in the midwest, primarily in Michigan where 34 were in use.

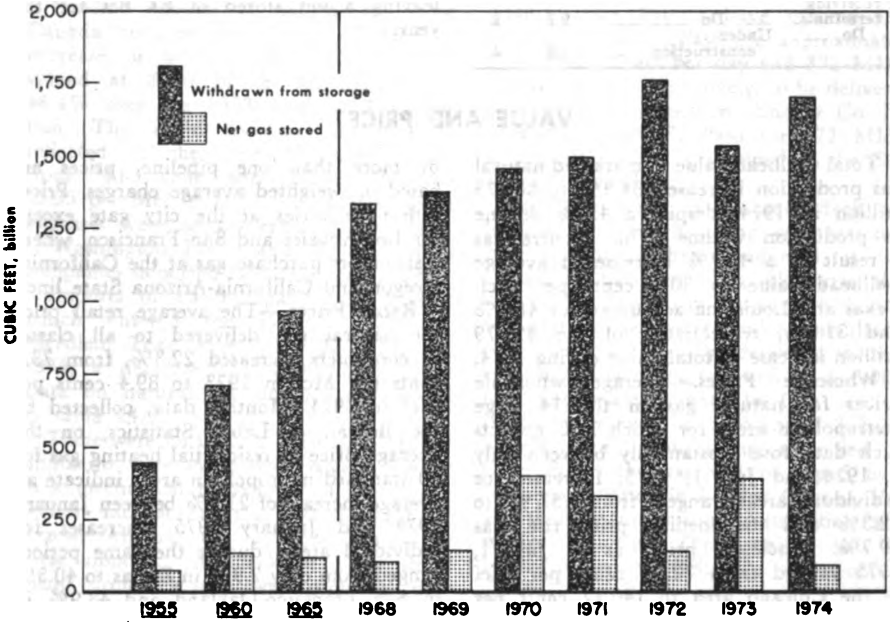

Figure 3.—Trends in net gas stored underground in U.S. storage fields.

The development of underground storage reservoirs has been an important factor in meeting peak natural gas demand, particularly in the residential house heating market in which there is a high degree of seasonal variation. There is a concentration of underground storage facilities relatively close to the largest markets for residential heating. Illinois had 612 Bcf of natural gas stored in 31 reservoirs and Pennsylvania had 557 Bcf stored in 68 reservoirs at yearend 1974. These two States accounted for 29.5% of the total stored gas in underground reservoirs.

In addition to underground storage there has been a marked growth in the aboveground storage of natural gas which has been liquefied by lowering its temperature. When natural gas is converted to a liquid by reducing its temperature to −258° F (−161° C), it occupies only 1/620 of the space necessary for conventional vapor storage. LNG storage is used for peak shaving purposes during the high-consumption, low-temperature winter months.

The following tabulation summarizes LNG storage data:

Facility	Status	Capacity (Bcf)	Number of plants
Peak shaving	Operational	51.6	54
Do	Under construction	6.7	7
Large satelite	Operational	5.2	20
Do	Under construction	2.5	8
Small satelite	Operational	.2	81
Import receiving terminals	Do	9.8	2
Do	Under construction	16.2	4

Where depleted oilfields or gasfields are not available, other types of underground storage reservoirs have been developed. For example, 51 aquifer type reservoirs were in use in 10 States at the end of 1974. Illinois was the leading State with 22, and Indiana ranked second with 10. Aquifer storage accounted for 22.1% of total underground storage capacity at yearend 1974. The increase in aquifer reservoir capacity during the year was negligible.

In 1974, the total amount of gas moved into underground storage totaled 1,784 Bcf as shown in table 19. During the same period, 1,701 Bcf was withdrawn, leaving a net stored of 83 Bcf for the year.

VALUE AND PRICE

Total wellhead value of marketed natural gas production increased 34.3% to $6,573 million in 1974, despite a 4.6% decline in production volume. This occurred as a result of a 40.7% increase in average wellhead value to 30.4 cents per Mcf. Texas and Louisiana accounted for 48.0% and 31.8%, respectively, of the $1,679 million increase in total value during 1974.

Wholesale Prices.—Average wholesale prices for natural gas in the 14 large metropolitan areas for which FPC collects such data rose substantially between July 1, 1974 and July 1, 1975. Increases for individual areas ranged from 15.7% to 92.3% and the median price rise was 29.7%. Wholesale prices as of July 1, 1975 ranged from 72.68 cents per Mcf in the Chicago area to 140.17 cents per Mcf in the Boston area.

A 7-year historical series of average wholesale natural gas prices in the 14 large metropolitan areas is shown in table 20. The wholesale prices for gas for those cities cited, are based on the effective FPC gas tariffs. In cities served by more than one pipeline, prices are based on weighted average charges. Prices reflect deliveries at the city gate except for Los Angeles and San Francisco, where distributors purchase gas at the California-Oregon and California-Arizona State lines.

Retail Prices.—The average retail price for natural gas delivered to all classes of consumers increased 22.3%, from 73.0 cents per Mcf in 1973 to 89.4 cents per Mcf in 1974. Monthly data, collected by the Bureau of Labor Statistics, on the average price of residential heating gas for 20 standard metropolitan areas indicate an average increase of 21.7% between January 1974 and January 1975. Increases for individual areas, during the same period, ranged from only 2.9% in Dallas to 40.3% in San Francisco-Oakland and 43.9% in Houston, where much of the current supply is obtained under relatively recent, high-priced intrastate contracts. A historical summary of average residential heating gas prices in 20 Standard Metropolitan Statistical areas appears in table 21.

FOREIGN TRADE

Exports of natural gas totaled 77 Bcf in 1974, about the same amount as in 1973. Of the total volume 65.5% was shipped from Port Nikiski, Alaska, to Japan as LNG. Exports via pipeline were almost equally divided between Canada and Mexico.

The LNG exported to Japan in 1974 totaled 50.26 Bcf valued at $37 million, compared with 48.35 Bcf valued at $27 million in 1973. The Alaskan LNG was exported rather than shipped to the lower 48 States for the following reasons: (1) There are no receiving terminals for

LNG tankers on the U.S. Pacific coast, and (2) Federal Maritime law requires U.S. flagships for all interstate seaborne trade, but no U.S. flag LNG tankers exist. Statistics on LNG exports for 1974 are shown in table 22.

Exports via pipeline to Canada in 1974 totaled 13.3 Bcf compared with 14.8 Bcf in 1973, a decline of 10.5%. Detroit was the exit point for most of these exports.

Natural gas exports via pipelines to Mexico continued to decline from 14.0 Bcf in 1973 to 13.3 Bcf in 1974. Comparisons of exports in 1973 and 1974 are shown in table 23.

Pipeline imports of natural gas from Canada declined in 1974 to 959 Bcf, a decrease of 6.6%. These imports were valued at $530 billion an increase of 48.4% over the 1973 total of $357 billion. The rapid increase in value is reflected in the average price of gas from 34.83 cents per Mcf in 1973 to 55.35 per Mcf in 1974. The greater price increases were on gas entering the States of Washington, Idaho, and Montana. Nine companies imported Canadian gas in 1974.

Imports of natural gas from Mexico, which entered the United States at McAllen, Tex., were only 222 MMcf in 1974, a decrease of 86.4% from 1973. Data on natural gas imports are shown in table 24.

There were no LNG imports in 1974. No shipments were made from Algeria owing to a mechanical breakdown of the liquefaction facilities at the LNG-1 plant at Arzew, Algeria, the previous source of these imports. The lack of LNG shipments from Canada was probably due to the full utilization, by the Canadians, of the output of the Montreal liquefaction facilities from which LNG was previously shipped to the United States by truck.

Two major LNG import receiving terminals were under construction during 1974, one on Elba Island near Savannah, Ga., and another at Cove Point, Md. These terminals will receive LNG in connection with the El Paso Natural Gas Co. contract with Société Nationale pour la Recherche, la Production, le Transport, la Transformation, et la Commercialisation des Hydrocarbures (SONATRACH), Algeria's National Oil and Gas Co. This 25-year contract, which has been approved by FPC, calls for the delivery of a quantity of LNG, equivalent to 1 Bcf of gas per day. Deliveries under this contract are expected to begin in 1977. The Columbia Gas System and the Consolidated Natural Gas System have entered into contracts with El Paso for approximately 319 MMcf of gas per day and 372 MMcf of gas per day, respectively, to be delivered to Cove Point. Southern Energy Co. has contracted with El Paso for 372 MMcf of gas per day to be received at the Elba Island terminal.

At Cove Point, a concrete deck unloading facility was being constructed a mile offshore. When completed, it will consist of two unloading platforms that will extend one-half mile along the channel allowing two tankers to unload simultaneously. The LNG will be delivered through two unloading lines enclosed in a 6,000-foot underwater tunnel to four onshore storage tanks with a capacity of 375,000 barrels each. After being regasified at Cove Point, the gas will be piped to a compressor station in Loudon County, Va., and then to transmission, distribution, and storage facilities. The terminal will be jointly owned by Columbia and Consolidated.

The receiving facility on Elba Island being built by Southern Energy Co., will have a single offshore berth that will be linked to the island by a 300-foot long trestle. Other proposed LNG projects are awaiting FPC approval.

WORLD REVIEW

World marketed production of natural gas continued to climb in 1974 when it totaled 47.1 Tcf. The United States accounted for 21.6 Tcf or 45.8% of this total. Data on world production of natural gas is shown on table 25.

The U.S.S.R. was second to the United States, accounting for 19.6% of world production. During 1974, marketed production in the U.S.S.R. was estimated to have been 9.2 Tcf, an increase of 10.6% over that of 1973. Combined exports to West Germany, Italy, Austria, and Finland totaled 210 Bcf in 1974. The 560-mile

U.S.S.R.-Bulgaria pipeline went onstream in August 1974, with an initial capacity of 97 MMcf of gas per day and reportedly will increase to 290 MMcf per day within 2 years. Also, nearing completion was a new pipeline to Hungary which will initially transport 97 MMcf of gas per day, and is expected to handle 340 to 390 MMcf per day by 1980.

A conditional $400 million agreement was signed in late 1974 by the U.S.S.R. and Japan along with two U.S. companies, El Paso Natural Gas Co. and Occidental Petroleum Corp., for the development of gasfields in Siberia. Under terms of the agreement, Japan would extend $100 million in credit upon approval of a $100 million loan from the U.S. Export-Import Bank. The pact calls for the delivery of about 1,900 MMcf of gas per day over a 25 year period, to be shared equally by Japan and the U.S. companies. El Paso would receive 75% of the U.S. share and 25% would go to Occidental. The gas would be liquefied for shipment to Japanese ports and to the U.S. west coast.

In Canada, which ranks third in natural gas production, marketed production totaled 3.0 Tcf in 1974, a decline of 2.6% from that of 1973. More than 85% of total Canadian production came from the Province of Alberta; British Columbia accounted for more than 11.5%. Exports to the United States totaled 959 Bcf, almost 40% of total production.

Net additions to gas reserves during 1974 of 4.2 Tcf increased total proved reserves to 56.7 Tcf, the largest increase since 1969. The inclusion, for the first time, of Mackenzie Delta reserves and successful exploration in Alberta were the most prominent contributions to this increase.

Although exploration declined in 1974, several significant gas discoveries were made. One of these discoveries, the Taglu field on Richards Island in the Mackenzie Delta area, contains upwards of 3 Tcf of gas. The Shell Niklintgak discovery, located about 11 miles southwest of the Taglu fields, also in the Mackenzie Delta area, tested up to 16 MMcf of gas per day. Preliminary estimates place reserves of this field at about 1 Tcf of gas and about 80 million barrels of oil. Three significant east coast offshore discoveries were made in 1974; two on the Labrador Shelf and one off the east tip of Prince Edward Island.

Exploration in the Arctic Islands declined in 1974, and no new gas discoveries were made. A major extension of more than 25 miles was added to the already sizable Drake Point field on the west coast of Melville Island. Drake Point is one of five substantial gas fields previously discovered by Panarctic Oil Ltd. The other four are Kristoffer Bay, Thor, Hecla, and King Christian. Sizable gas reserves were also discovered previously in two locations on King Christian Island by Dome Petroleum Ltd.

Three separate consortiums composed of pipeline and oil companies were in the process of investigating the feasibility of building pipeline facilities from the Canadian Arctic to market areas during 1974.

Canadian Arctic Gas Study, Ltd. (CAGSL), a consortium of U.S. and Canadian companies, filed an application in March 1974, with the National Energy Board (NEB) to construct a $5.7 billion pipeline which would bring Mackenzie Delta and Alaska gas to Southern markets.

The Alberta Gas Trunk Line Co., Ltd., late in 1974, withdrew from CAGSL and was joined by Westcoast Transmission Co., Ltd. as a partner in Foothills Pipe Lines Ltd. This company filed application to build a pipeline (Maple Leaf pipeline) to transport only Canadian natural gas from the Mackenzie Delta.

Marketed production in the Netherlands, Western Europe's largest gas producer and exporter, totaled 3.0 Tcf in 1974, an increase of 18.5% over 1973. The Netherlands gas reserves were estimated at 77 Tcf (including 17 Tcf offshore) in 1974, a decline of 7.8 Tcf from the 1973 estimate. Groningen field, with the largest share of gas reserves, produced over 95% of the Netherlands total output. Exploration activity was increased offshore in 1974, and production licenses were granted to two North Sea offshore gasfields. In 1974, the first offshore gas was delivered through a new pipeline to West Germany. Natural gas exports went principally to West Germany, Belgium, and France. A pipeline to Italy, completed in 1974, will supply 580 MMcf of gas per day to that country for 20 years, and about 50 MMcf of gas per day to Switzerland.

Romania's 1974 marketed production

was estimated at 1.0 Tcf, an increase of 3% compared with 1973. Most of the gas produced was used domestically. A tentative agreement, signed in 1974 with Petróleos Mexicano (Pemex), will allow Romania to use Pemex technology for exploration in the Black Sea. Efforts were underway to attract the interest of U.S. firms in providing offshore technology.

The North Sea is one of the fastest developing natural gas areas in the world. Although exploration continued at a high rate during 1974, emphasis is turning toward development and production. Marketed production, from five fields in the United Kingdom's portion of the North Sea, rose 13.9%, from 1.0 Tcf of gas in 1973 to 1.2 Tcf in 1974. Upon completion of a 700-mile pipeline under construction, an additional 2,000 MMcf of gas per day will be available from the Brent field and the British portion of the Anglo-Norwegian Frigg field. The United Kingdom's 1974 reserves were estimated at over 44 Tcf.

Norway's proved reserves, most of which were in the offshore Ekofisk oil and gasfield, totaled 24.7 Tcf. During 1974, a 270-mile, 36-inch gas pipeline was completed from the Ekofisk field to a 2,200-MMcf-per-day processing plant at Emden, West Germany. Beginning in 1975, gas processed by this plant will be distributed to West German, French, Dutch, and Belgian companies.

Marketed production in Algeria totaled 211 Bcf in 1974, an increase of 26% over 1973. Algeria's State-owned company, SONATRACH, projects annual export sales of nearly 2.85 Tcf by 1980. Approximately 85% of these exports are expected to be in the form of LNG. In 1974 Algeria's third LNG plant was under construction at Bethioua, near Arzew. The initial plans are for a capacity of 1 Bcf of gas per day.

A 25-year contract between SONATRACH and Italy's State-owned Ente Nazionale Idrocarburi (ENI) calls for the delivery of 1 Bcf of gas per day via pipeline. The 1,550-mile pipeline, portions of which will cross the Mediterrean Sea to Italy, will start at Hassi R'Mel gasfield in Algeria, and is scheduled for completion in 1978. ENI completed the first stage of the line, a section in the Messina Straits, during 1974.

SONATRACH continued negotiations during 1974 with several European countries to provide long-term supplies of LNG.

TECHNOLOGY

Predicted shortages of natural gas have stimulated Government and industry research in coal gasification. Five pilot projects for the development and testing of processes for the production of high-Btu gas, similar to pipeline-quality natural gas, from coal were operational or under construction at yearend 1974. Some research was also in progress for the development of a process for the production of low-Btu gas from coal.

A Bureau of Mines experimental coalbed degasification project involving a methane gathering system installed in a coal mine near Bula, W. Va., delivered 170 MMcf of natural gas to Consolidated Gas Supply Corp. in 1974. However, the rate of flow from this project declined 15% during the year. The Bureau was in the process of tapping an 8-foot coal seam about 3 miles from the original project at yearend. These experiments were being carried out with a dual purpose; to provide additional natural gas supplies for distribution, and to reduce coal mining hazards.

Efforts to supplement natural gas supplies through the gasification of liquid fuels, principally naphtha, continued. Eleven such synthetic gas plants were operational, and three were planned as of yearend 1974.

Other gasification projects in progress involved biomass conversion. Methane was collected from sanitary landfills and sewage plants at several locations, and at least one project to produce pipeline-quality gas from animal waste by the process of anaerobic digestion was under development.

In addition to gasification schemes, research has also focused on fracturing techniques which stimulate flow from economically submarginal gas reservoirs. A massive hydraulic fracturing project initiated in the Green River Basin near Pinedale, Wyo., during 1974 was expected to utilize over 1 million gallons of frac fluid and about 3.5 million pounds of proppant sand that could create a fracture over 2,000 feet long in a low-permeability sandstone formation. Efforts were also in progress to fracture reservoirs in the nearly impermeable Upper Devonian shales of the eastern United States. These shales underlie about 12 States, including those which comprise the major northeastern markets, and are estimated to contain producible gas which may exceed the Nation's total current proved reserves.

Table 2.—Gas pipeline failures reported during 1973–74 [1]

System and cause of failure	Total number of failures		Fatalities				Injuries			
			Employees		Non-employees		Employees		Non-employees	
	1973	1974	1973	1974	1973	1974	1973	1974	1973	1974
Distribution:										
Corrosion	133	108	1	--	2	3	--	3	69	27
Damage by outside forces	602	756	--	1	16	16	13	13	133	203
Construction defect or material failure	98	94	--	--	11	--	10	4	53	28
Other causes	60	59	--	--	3	--	25	11	30	25
Total	893	1,017	1	1	32	19	48	31	285	283
Transmission and gathering:										
Corrosion	63	78	--	--	--	--	1	--	--	4
Damage by outside forces	272	274	--	--	--	--	--	1	15	8
Construction defect or material failure	111	81	--	--	--	3	--	--	--	--
Other causes	25	27	1	1	1	--	2	6	1	1
Total	471	460	1	1	1	3	3	7	16	13
Grand total	1,364	1,477	2	2	33	22	51	38	301	296

[1] Includes 105 failure incidents which occurred in 1973 but reported to the Office of Pipeline Safety in early 1974. Of these 105 failures, 78 were gas distribution incidents in which 7 fatalities and 26 injuries resulted. The remaining 27 incidents were transmission-gathering failures in which no fatalities or injuries occurred.

Source: Office of Pipeline Safety, Department of Transportation.

Table 3.—Quantity and value of marketed production of natural gas in the United States

State	1973			1974		
	Quantity (million cubic feet) [1]	Value (thousand dollars)	Average wellhead value (cents per thousand cubic feet)	Quantity (million cubic feet) [1]	Value (thousand dollars)	Average wellhead value (cents per thousand cubic feet)
Alabama	11,271	4,307	38.2	27,865	20,704	74.3
Alaska	131,007	19,483	14.9	128,935	21,919	17.0
Arizona	125	23	18.4	224	45	20.0
Arkansas	157,529	28,985	18.4	123,975	32,234	26.0
California	449,369	167,615	37.3	365,354	160,756	44.0
Colorado	137,725	24,304	17.7	144,629	28,926	20.0
Florida	33,857	11,613	34.3	38,137	20,441	53.6
Illinois	1,638	573	35.0	1,436	574	40.0
Indiana	276	38	13.8	176	25	14.0
Kansas	893,118	138,521	15.5	886,782	147,206	16.6
Kentucky	62,396	21,839	35.0	71,876	35,938	50.0
Louisiana	8,242,423	1,846,303	22.4	7,753,631	2,380,365	30.7
Maryland	298	69	23.3	133	32	24.0
Michigan	44,579	17,495	39.2	69,133	34,843	50.4
Mississippi	99,706	22,846	22.9	78,787	23,242	29.5
Missouri	33	8	24.2	33	10	31.4
Montana	56,175	13,240	23.6	54,873	13,883	25.3
Nebraska	3,836	698	18.2	2,538	863	34.0
New Mexico	1,218,749	287,889	23.6	1,244,779	390,861	31.4
New York	4,539	1,590	35.0	4,990	2,745	55.0
North Dakota	27,703	5,457	19.7	31,206	6,210	19.9
Ohio	93,610	39,786	42.5	92,055	44,371	48.2
Oklahoma	1,770,980	334,110	18.9	1,638,942	458,904	28.0
Pennsylvania	78,514	32,976	42.0	82,637	36,360	44.0
Tennessee	20	6	30.0	17	6	36.0
Texas	8,513,850	1,735,221	20.4	8,170,798	2,541,118	31.1
Utah	42,715	8,159	19.1	50,522	20,815	41.2
Virginia	5,101	1,688	33.1	7,096	3,619	51.0
West Virginia	208,676	64,481	30.9	202,306	66,356	32.8
Wyoming	357,731	64,749	18.1	326,657	80,031	24.5
Total	22,647,549	4,894,072	21.6	21,600,522	6,573,402	30.4

[1] Marketed production of natural gas represents gross withdrawals less gas used for repressuring and quantities vented and flared.

Source: Figures based on reports received from State agencies and Bureau of Mines estimates.

Table 4.—Gross withdrawals and disposition of natural gas in the United States

(Million cubic feet at 14.73 psia)

State	Gross withdrawals			Disposition		
	From gas wells	From oil wells	Total[1]	Marketed production	Repressuring	Vented and flared[2]
1973						
Alabama	8,148	5,013	13,161	11,271	--	1,890
Alaska	123,986	99,302	223,288	131,007	87,302	4,979
Arizona	139	263	402	125	--	277
Arkansas	120,068	39,408	159,476	157,529	--	1,947
California	291,984	221,602	513,586	449,369	62,218	1,999
Colorado	105,541	35,901	141,442	137,725	709	3,008
Florida	--	33,857	33,857	33,857	--	--
Illinois	1,638	(3)	1,638	1,638	--	--
Indiana	276	(3)	276	276	--	--
Kansas	745,662	151,627	897,289	893,118	1,794	2,377
Kentucky	62,396	--	62,396	62,396	--	--
Louisiana	7,347,732	1,143,462	8,491,194	8,242,423	146,680	102,091
Maryland	298	--	298	298	--	--
Michigan	23,272	22,424	45,696	44,579	--	1,117
Mississippi	90,776	26,985	117,761	99,706	7,288	10,767
Missouri	33	(3)	33	33	--	--
Montana	55,329	5,602	60,931	56,175	1,065	3,691
Nebraska	2,610	2,060	4,670	3,836	--	834
New Mexico	954,632	268,930	1,223,562	1,218,749	1,022	3,791
New York	4,539	(3)	4,539	4,539	--	--
North Dakota	282	49,954	50,236	27,703	--	22,533
Ohio	76,931	16,679	93,610	93,610	--	--
Oklahoma	1,455,293	434,494	1,889,787	1,770,980	82,396	36,411
Pennsylvania	76,234	2,280	78,514	78,514	--	--
South Dakota	10	--	10	--	10	--
Tennessee	20	165	185	20	--	165
Texas	7,282,804	2,007,141	9,289,945	8,513,850	739,962	36,133
Utah	22,849	55,662	78,511	42,715	28,132	7,664
Virginia	5,101	--	5,101	5,101	--	--
West Virginia	207,702	1,114	208,816	208,676	140	--
Wyoming	305,315	71,677	376,992	357,731	12,643	6,618
Total	19,371,600	4,695,602	24,067,202	22,647,549	1,171,861	248,292
1974						
Alabama	23,970	5,387	29,357	27,865	--	1,492
Alaska	125,349	104,614	229,963	128,935	89,504	11,524
Arizona	27	223	250	224	--	26
Arkansas	92,265	33,426	125,691	123,975	--	1,716
California	222,673	204,301	426,974	365,354	60,060	1,560
Colorado	108,962	38,890	147,852	144,629	266	2,957
Florida	-	38,137	38,137	38,137	--	--
Illinois	1,436	(3)	1,436	1,436	--	-
Indiana	176	(3)	176	176	--	--
Kansas	747,580	141,870	889,450	886,782	1,779	889
Kentucky	71,876	--	71,876	71,876	--	--
Louisiana	7,037,239	882,571	7,919,810	7,753,631	134,607	31,572
Maryland	133	--	133	133	--	--
Michigan	45,745	24,719	70,464	69,133	63	1,268
Mississippi	76,295	22,700	98,995	78,787	9,421	10,787
Missouri	33	(3)	33	33	--	--
Montana	51,644	7,880	59,524	54,873	750	3,901
Nebraska	2,194	2,481	4,675	2,538	--	2,137
New Mexico	944,515	309,784	1,254,299	1,244,779	8,293	1,227
New York	4,990	(3)	4,990	4,990	--	-
North Dakota	287	48,779	49,066	31,206	-	17,860
Ohio	77,114	16,749	93,863	92,055	1,808	--
Oklahoma	1,425,283	331,346	1,756,629	1,638,942	83,488	34,199
Pennsylvania	82,735	(3)	82,735	82,637	--	98
South Dakota	48	--	48	--	48	--
Tennessee	17	376	393	17	--	376
Texas	7,029,873	1,829,171	8,859,044	8,170,798	653,815	34,431
Utah	21,433	58,540	79,973	50,522	24,192	5,259
Virginia	7,096	--	7,096	7,096	--	--
West Virginia	202,306	(3)	202,306	202,306	--	--
Wyoming	265,918	78,637	344,555	326,657	11,796	6,102
Total	18,669,212	4,180,581	22,849,793	21,600,522	1,079,890	169,381

[1] Marketed production plus quantities used in repressuring and vented and flared.
[2] Partly estimated; includes direct losses on producing properties and residue blown to the air.
[3] Not reported separately, included under gross withdrawals from gas wells.

Source: Figures based on reports from State agencies and Bureau of Mines estimates.

Table 5.—Gas and oil well completions in the United States, by State, 1969–74

State	Gas completions [1]						Oil completions [2]					
	1969	1970	1971	1972	1973	1974	1969	1970	1971	1972	1973	1974
Alabama	1	5	6	9	10	16	10	7	8	13	18	16
Alaska	11	5	1	2	3	4	38	67	27	12	20	27
Arizona	2	--	2	1	1	--	9	1	--	5	--	3
Arkansas	40	36	29	39	40	41	151	100	127	96	91	99
California	59	56	60	62	65	69	1,543	1,697	1,459	1,045	879	1,567
Colorado	47	47	148	124	148	201	158	142	154	300	228	218
Florida	--	--	--	--	--	--	6	14	8	65	24	9
Illinois	5	5	16	18	13	11	417	311	252	255	240	357
Indiana	7	4	2	5	8	21	129	93	81	92	67	136
Kansas	184	108	112	368	384	389	1,271	1,044	1,099	880	592	989
Kentucky	142	111	135	166	157	127	296	275	244	230	158	195
Louisiana:												
North	123	157	237	451	269	458	309	263	390	291	234	326
South	230	232	200	234	284	190	471	497	398	375	337	283
Offshore	190	150	184	133	231	141	372	382	258	253	287	216
Total Louisiana	543	539	621	818	784	789	1,152	1,142	1,046	919	858	825
Michigan	15	19	33	34	41	52	73	49	81	87	73	116
Mississippi	16	12	13	13	28	26	195	211	175	87	70	67
Missouri	--	--	1	--	--	2	17	10	6	--	--	7
Montana	31	74	33	125	123	145	186	64	45	83	46	60
Nebraska	1	2	1	2	--	5	57	39	47	48	33	40
New Mexico	263	159	186	238	498	463	561	341	401	502	280	350
New York	12	17	7	22	27	98	112	69	83	96	97	153
North Dakota	--	1	1	--	--	--	49	48	49	23	40	42
Ohio	395	683	608	721	940	1,050	645	503	391	426	393	567
Oklahoma	397	321	238	341	539	744	1,604	1,343	1,174	1,025	898	1,149
Pennsylvania	277	250	199	297	434	468	547	441	394	534	525	671
South Dakota	--	--	--	--	--	--	--	--	2	4	5	1
Tennessee	7	4	23	9	10	12	4	24	57	14	24	61
Texas	903	774	810	943	1,475	1,843	4,256	4,137	3,880	3,963	3,686	4,402
Utah	16	10	6	13	25	12	47	29	30	73	104	118
Virginia	--	--	--	18	7	55	1	--	--	--	--	--
West Virginia	652	553	496	488	514	556	135	192	133	84	72	121
Wyoming	57	45	43	52	61	40	699	627	405	345	381	418
Grand total	4,083	3,840	3,830	4,928	6,335	7,239	14,368	13,020	11,858	11,306	9,902	12,784

[1] Includes multiple completion wells that produce gas from all zones.

[2] Includes multiple completion wells that produce gas from one or more zones but oil from at least one zone.

Source: American Petroleum Institute Quarterly Review of Drilling Statistics for the United States, Annual Summaries 1969 to 1974, inclusive.

Table 6.—Exploratory wells drilled in the United States

State	Gas completions [1]						Oil Completions [2]					
	1969	1970	1971	1972	1973	1974	1969	1970	1971	1972	1973	1974
Alabama	--	1	2	6	5	4	3	2	3	2	4	5
Alaska	--	1	--	1	1	3	--	23	1	--	2	2
Arizona	--	--	1	1	1	--	1	--	--	--	--	--
Arkansas	5	4	2	1	2	2	11	7	9	7	4	8
California	7	8	5	9	17	16	24	28	21	17	17	28
Colorado	14	15	27	29	29	26	46	26	29	71	38	25
Florida	--	--	--	--	--	--	1	2	--	2	3	2
Illinois	1	2	4	2	1	3	31	16	24	20	22	25
Indiana	5	3	1	3	3	6	25	8	14	11	11	18
Kansas	25	--	14	26	40	33	173	131	131	117	93	98
Kentucky	20	26	12	18	16	20	29	21	23	30	18	24
Louisiana	93	69	72	79	54	61	57	40	43	24	22	24
Michigan	3	7	13	21	31	34	7	9	26	34	38	50
Mississippi	3	2	3	4	15	6	30	25	13	9	18	23
Missouri	--	--	--	--	--	1	2	--	--	--	--	--
Montana	9	20	16	29	28	35	23	21	4	15	10	10
Nebraska	--	--	--	--	--	3	17	10	7	10	7	18
New Mexico	11	8	7	27	25	48	26	16	6	14	9	3
New York	1	2	3	3	3	19	--	--	--	1	2	--
North Dakota	--	--	--	--	--	--	15	7	3	7	4	11
Ohio	24	17	7	24	31	117	5	1	--	2	--	20
Oklahoma	57	43	27	55	69	61	110	59	42	37	35	51
Pennsylvania	10	21	8	20	41	42	4	2	1	3	3	11
South Dakota	--	--	--	--	--	--	--	--	2	--	4	--
Tennessee	6	1	14	7	8	11	3	5	16	4	6	17
Texas	264	179	172	183	410	562	330	256	186	179	207	278
Utah	6	4	4	2	13	4	8	9	8	22	4	4
Virginia	--	--	--	--	2	5	--	--	--	--	--	--
West Virginia	37	31	13	35	39	53	2	--	1	1	4	5
Wyoming	15	7	10	16	16	19	101	66	33	45	34	54
Grand total	616	471	437	601	900	1,194	1,084	790	651	684	619	814

[1] Includes multiple completion wells that produce gas from all zones.

[2] Includes multiple completion wells that produce gas from one or more zones but oil from at least one zone.

Source: American Petroleum Institute Quarterly Review of Drilling Statistics for the United States, Annual Summaries 1969 to 1974, inclusive.

Table 7.—Producing gas and condensate wells in the United States[1]

PAD district and State	Dec. 31, 1969	Dec. 31, 1970	Dec. 31, 1971	Dec. 31, 1972	Dec. 31, 1973	Dec. 31, 1974
District 1:						
Maryland	13	16	14	16	15	15
New York	818	600	600	650	789	700
Pennsylvania	16,600	16,239	16,586	16,600	16,600	17,123
Virginia	111	115	115	130	178	174
West Virginia	18,600	20,702	21,025	21,324	21,400	21,450
Total	36,142	37,672	38,340	38,720	38,982	39,462
District 2:						
Illinois	5	8	14	31	36	37
Indiana	263	50	83	87	106	474
Kansas	8,567	8,660	8,585	8,621	8,785	8,800
Kentucky	6,413	6,913	7,413	7,099	7,224	7,307
Michigan	211	1,235	1,171	1,317	1,145	508
Missouri	11	11	2	3	2	3
Nebraska	35	35	29	29	29	25
North Dakota	33	29	29	21	44	34
Ohio	7,334	7,789	8,179	8,630	9,406	10,033
Oklahoma	8,432	8,168	8,507	8,457	8,868	9,401
Tennessee	26	15	20	45	6	13
Total	31,330	32,913	34,032	34,340	35,651	36,635
District 3:						
Alabama	1	2	--	15	15	6
Arkansas	998	1,008	1,013	1,041	876	1,172
Louisiana	9,354	9,690	9,748	9,456	10,551	9,248
Mississippi	322	325	400	252	250	239
New Mexico	9,100	8,848	9,388	9,679	9,711	9,915
Texas	23,689	23,417	23,280	23,373	23,805	24,646
Total	43,464	43,290	43,829	43,816	45,208	45,226
District 4:						
Colorado	805	861	928	934	1,050	1,347
Montana	1,098	739	1,056	1,116	1,118	1,450
Utah	171	173	178	200	158	114
Wyoming	521	800	840	887	850	900
Total	2,595	2,573	3,002	3,137	3,176	3,811
District 5:						
Alaska	44	51	40	50	52	52
Arizona	4	4	5	4	4	1
California	897	980	962	1,086	1,095	1,142
Total	945	1,035	1,007	1,140	1,151	1,195
Total United States	[r] 114,476	117,483	120,210	121,153	124,168	126,329

[r] Revised.

[1] Based on State reports, State estimates, and World Oil.

Table 8.—Consumption of natural gas by use and State, 1974

Region and State	Delivered to consumers: Quantity (million cubic feet)	Delivered to consumers: Value (thousand dollars)	Extraction loss: Quantity (million cubic feet)	Extraction loss: Value (thousand dollars)	Lease and plant fuel: Quantity (million cubic feet)	Lease and plant fuel: Value (thousand dollars)	Pipeline fuel: Quantity (million cubic feet)	Pipeline fuel: Value (thousand dollars)	Total: Quantity (million cubic feet)	Total: Value (thousand dollars)
New England:										
Connecticut	66,299	157,633	--	--	--	--	44	22	66,343	157,655
Maine, New Hampshire, Vermont	14,697	26,283	--	--	--	--	--	--	14,697	26,283
Massachusetts	154,594	359,975	--	--	--	--	674	269	155,268	360,244
Rhode Island	23,759	52,006	--	--	--	--	22	9	23,781	52,015
Total	259,349	595,897	--	--	--	--	740	300	260,089	596,197
Middle Atlantic:										
New Jersey	274,505	497,484	--	--	--	--	545	147	275,050	497,631
New York	624,137	1,053,660	--	--	340	227	3,016	934	627,493	1,054,821
Pennsylvania	692,980	881,312	75	43	1,649	840	20,919	8,367	715,623	890,562
Total	1,591,622	2,432,456	75	43	1,989	1,067	24,480	9,448	1,618,166	2,443,014
East North Central:										
Illinois	1,130,225	1,205,891	13,821	4,837	102	34	19,067	5,529	1,163,215	1,216,291
Indiana	519,352	480,478	--	--	--	--	12,520	3,505	531,872	483,983
Michigan	921,898	1,035,194	1,921	788	3,194	1,245	10,951	5,037	937,964	1,042,264
Ohio	1,073,671	1,106,803	--	--	2,957	1,655	10,023	3,207	1,086,651	1,111,665
Wisconsin	375,721	395,691	--	--	--	--	5,427	1,628	381,148	397,319
Total	4,020,867	4,224,057	15,742	5,625	6,253	2,934	57,988	18,906	4,100,850	4,251,522
West North Central:										
Iowa	350,413	285,889	--	--	--	--	17,182	4,467	367,595	290,356
Kansas	477,071	258,011	43,416	14,827	35,350	17,321	74,592	20,139	630,429	309,798
Minnesota	348,038	333,788	--	--	--	--	3,606	1,189	351,644	334,977
Missouri	400,944	362,647	--	--	--	--	8,940	2,592	409,884	365,239
Nebraska	210,083	151,693	460	110	1,194	298	11,530	2,767	223,267	154,868
North Dakota	23,944	24,721	2,571	720	11,483	2,526	32	10	38,030	27,977
South Dakota	32,060	33,549	--	--	--	--	16	5	32,076	33,554
Total	1,842,553	1,450,298	46,447	15,157	48,027	20,145	115,898	31,169	2,052,925	1,516,769
South Atlantic:										
Delaware	20,365	30,464	--	--	--	--	--	--	20,365	30,464
Florida	283,770	228,385	3,369	1,617	2,700	1,377	3,081	1,047	292,920	232,426
Georgia	325,489	288,692	--	--	--	--	4,850	1,358	330,339	290,050
Maryland and District of Columbia	197,176	295,153	--	--	392	299	1,763	476	199,331	295,928
North Carolina	135,721	148,527	--	--	--	--	4,496	1,124	140,217	149,651
South Carolina	129,827	124,808	--	--	--	--	2,164	584	131,991	125,392
Virginia	139,121	186,034	--	--	307	141	4,222	1,308	143,650	187,483
West Virginia	164,777	145,809	9,605	3,362	1,909	725	15,684	7,057	191,975	156,953
Total	1,396,246	1,447,872	12,974	4,979	5,308	2,542	36,260	12,954	1,450,788	1,468,347

East South Central:										
Alabama	254,133	211,489	501	230	1,301	624	19,327	5,604	275,262	217,897
Kentucky	197,421	173,391	5,557	1,556	1,206	349	29,376	3,519	233,560	183,815
Mississippi	220,534	146,088	679	210	5,357	1,285	50,308	14,086	276,878	161,669
Tennessee	235,100	184,252	--	--	1,087	467	23,984	6,715	260,171	191,434
Total	907,188	715,170	6,737	1,996	8,951	2,725	122,995	34,924	1,045,871	754,815
West South Central:										
Arkansas	272,590	163,014	952	305	4,246	1,188	13,557	4,067	291,345	168,574
Louisiana	1,585,030	993,787	194,329	102,994	347,098	97,187	76,236	21,346	2,202,693	1,215,314
Oklahoma	555,166	291,291	62,860	22,001	80,780	17,771	24,064	6,256	722,870	337,319
Texas	3,552,495	1,969,196	448,993	25,966	817,194	228,814	93,799	26,263	4,912,481	2,250,239
Total	5,965,281	3,417,288	707,134	151,266	1,249,318	344,960	207,656	57,932	8,129,389	3,971,446
Mountain:										
Arizona	170,221	135,047	--	--	--	--	22,225	6,223	192,446	141,270
Colorado	304,770	215,154	6,210	2,546	5,822	2,270	2,464	665	319,266	220,635
Idaho	49,084	49,392	--	--	--	--	3,973	1,748	53,057	51,140
Montana	74,505	59,920	857	249	3,683	736	1,721	395	80,766	61,300
Nevada	63,438	62,526	--	--	--	--	--	--	63,438	62,526
New Mexico	181,638	116,891	54,986	19,795	43,452	9,559	32,346	9,703	312,422	155,948
Utah	116,232	86,803	3,958	1,702	4,193	1,425	590	200	124,973	90,130
Wyoming	73,905	36,195	14,072	4,222	14,302	3,289	7,539	1,809	109,818	45,516
Total	1.033.793	761,928	80,083	28.514	71.452	17,279	70,858	20,743	1,256,186	828,464
Pacific:										
Alaska	48.362	37,072	1,097	340	14.402	3.744	110	33	63.971	41,189
California	1,743,734	1,654,969	17,201	9,461	71,686	30,824	18,993	8.546	1,851,614	1,703,800
Oregon	90.750	116,036	--	--	--	--	7,301	3,431	98,051	119,467
Washington	177,210	194,955	--	--	--	--	5,513	2,426	182,723	197,381
Total	2.060.056	2.003.032	18.298	9.801	86 088	34.568	31,917	14,436	2,196,359	2,061,837
Total United States	19,076,955	17,047,998	887,490	217,381	1,477,386	426,220	668,792	200,812	22,110,623	17,892,411

NOTE. All quantities at pressure base of 14.73 psia.

Table 9.—Quantity and value of natural gas delivered to consumers in 1974, by type of consumer and by State

Region and State	Residential			Commercial			Industrial[1]		Electric utilities		Other consumers[2]		Total	
	Number of consumers (thousands)	Quantity (million cubic feet)	Value (thousand dollars)	Number of consumers (thousands)	Quantity (million cubic feet)	Value (thousand dollars)	Quantity (million cubic feet)	Value (thousand dollars)	Quantity (million cubic feet)	Value (thousand dollars)	Quantity (million cubic feet)	Value (thousand dollars)	Quantity (million cubic feet)	Value (thousand dollars)
New England:														
Connecticut	372	33,417	93,228	30	15,706	35,496	16,100	27,853	535	342	541	709	66,299	157,633
Maine, Vermont, New Hampshire	69	6,174	14,674	6	3,303	6,319	3,458	4,143	1,624	988	138	164	14,697	26,283
Massachusetts	1,027	85,495	231,691	71	33,696	74,805	24,409	41,739	7,306	6,356	3,688	5,384	154,594	359,975
Rhode Island	155	12,950	33,028	9	3,742	8,307	4,493	7,773	1,919	1,842	655	1,061	23,759	52,006
Total	1,623	138,036	372,621	116	56,447	124,927	48,460	81,508	11,384	9,528	5,022	7,318	259,349	595,897
Middle Atlantic:														
New Jersey	1,621	135,843	305,647	181	57,042	106,669	65,419	72,615	15,033	10,824	1,168	1,729	274,505	497,484
New York	3,926	341,032	682,064	278	118,693	194,657	108,542	120,482	38,231	34,408	17,639	22,049	624,137	1,053,660
Pennsylvania	2,232	271,877	451,316	158	94,162	121,469	310,783	292,136	7,825	6,808	8,333	9,583	692,980	881,312
Total	7,779	748,752	1,439,027	607	269,897	422,795	484,744	485,233	61,089	52,040	27,140	33,361	1,591,622	2,432,456
East North Central:														
Illinois	2,890	461,746	623,357	222	212,922	217,180	409,573	331,754	42,792	31,238	3,192	2,362	1,130,225	1,205,891
Indiana	1,069	158,130	202,406	101	74,085	78,530	271,377	189,964	13,958	7,956	1,802	1,622	519,352	480,478
Michigan	2,048	346,116	474,179	181	181,738	205,364	330,418	300,680	56,172	46,623	7,454	8,348	921,898	1,035,194
Ohio	2,581	435,800	540,392	204	182,776	197,398	424,694	344,002	20,680	15,096	9,721	9,915	1,073,671	1,106,803
Wisconsin	851	116,314	174,471	72	58,629	69,182	159,887	123,113	33,815	24,326	7,076	4,599	375,721	395,691
Total	9,439	1,518,106	2,014,805	780	710,150	767,654	1,595,949	1,289,513	167,417	125,239	29,245	26,846	4,020,867	4,224,057
West North Central:														
Iowa	614	91,936	112,162	68	61,033	58,592	133,224	79,934	61,201	33,661	3,019	1,540	350,413	285,889
Kansas	633	93,363	84,027	60	50,194	30,618	164,768	65,907	165,479	76,120	3,267	1,339	477,071	258,011
Minnesota	695	112,922	159,220	69	59,951	65,347	106,236	67,991	38,468	18,080	30,461	23,150	348,038	333,788
Missouri	1,086	152,832	194,097	87	74,133	71,168	109,702	63,627	48,119	24,060	16,158	9,695	400,944	362,647
Nebraska	348	49,403	56,319	54	38,294	32,167	70,362	37,995	48,020	23,050	4,004	2,162	210,083	151,693
North Dakota	59	9,556	11,372	9	11,528	11,528	2,801	1,793	59	28	--	--	23,944	24,721
South Dakota	84	11,338	14,626	11	10,994	12,863	5,418	3,901	3,633	1,780	677	379	32,060	33,549
Total	3,519	521,350	631,823	358	306,127	282,283	592,511	321,148	364,979	176,779	57,586	38,265	1,842,553	1,450,298
South Atlantic:														
Delaware	78	7,380	15,572	5	3,169	5,165	8,925	9,014	391	718	--	--	20,865	30,464
Florida	379	14,798	42,160	37	18,619	34,818	91,588	68,691	154,862	80,528	3,903	2,188	283,770	228,385
Georgia	828	76,207	106,690	68	41,189	42,425	161,879	113,315	43,086	23,697	3,128	2,565	325,489	288,692
Maryland and District of Columbia	856	82,999	157,486	64	36,277	53,934	57,584	68,026	13,513	8,108	6,803	7,599	197,176	295,153
North Carolina	299	26,830	45,343	42	17,183	23,369	86,817	75,531	1,072	847	3,819	3,437	135,721	148,527
South Carolina	258	20,383	40,155	25	13,618	15,933	73,114	52,643	21,510	15,272	1,202	805	129,827	124,808
Virginia	481	48,160	90,059	41	26,785	38,035	50,991	47,422	4,689	2,532	8,496	7,986	139,121	186,034

West Virginia	390	53,793	59,172	33	22,678	20,410	86,022	64,517	376	184	1,908	1,526	164,777	145,809
Total	3,569	330,545	556,587	310	179,518	234,139	616,926	499,159	289.999	131,881	29,264	26,106	1,396,246	1,447,872
East South Central:														
Alabama	625	55,117	85,431	42	34,330	30,210	158,709	92,051	4,958	3,024	1,019	723	254,132	211,489
Kentucky	586	76,129	33,742	57	35,387	32,910	73,509	48,516	5,463	2,677	6,932	5,546	197,421	173,391
Mississippi	350	28,900	35,547	38	14,651	12,160	124,038	70,702	42,092	20,625	10,583	7,054	220,534	146,088
Tennessee	440	43,586	50,996	57	40,685	41,092	146,863	89,586	--	--	3,966	2,578	235,100	184,252
Total	2,001	203,732	255,716	194	125,053	116,372	503,110	300.855	52.518	26,326	22,771	15,901	907,188	715,170
West South Central:														
Arkansas	415	44,110	46,757	53	29,643	22,825	157,792	75,740	39,648	17,049	1,397	643	272,590	163,014
Louisiana	904	91,844	102,865	69	29,211	23,369	1,091,472	687,627	843,617	168,372	28,886	11,554	1,585,030	998,787
Oklahoma	667	72,937	76,584	65	37,844	28,761	147,336	72,195	293,819	111,651	3,230	2,100	555,166	291,291
Texas	2,825	222,608	260,446	256	91,008	79,177	1,860,637	986,188	1,334,837	627,373	43,410	16,062	3,552,495	1,969,196
Total	4,811	431,494	486,652	443	187,706	154,132	3,257,237	1,821,700	2,011,921	924,445	76,923	30,359	5,965,281	3,417,288
Mountain:														
Arizona	529	32,335	48,508	44	30,661	25,755	64,893	37,638	40,251	21,736	2,081	1,415	170,221	135,047
Colorado	661	91,809	91,809	84	63,121	53,661	78,394	37,629	66,245	29,148	5,191	2,907	304,770	215,154
Idaho	83	9,652	17,374	13	7,219	9,168	31,332	22,246	60	29	821	575	49,084	49.392
Montana	157	21,590	24,181	22	14,353	13,348	35,202	20,417	1,111	422	2,249	1,552	74,505	59,920
Nevada	101	9,388	16,147	5	8,424	9,856	9,272	8,159	30,700	23,332	5,654	5,032	63,438	62,525
New **Mexico**	238	25,331	31,410	26	13,308	11,977	64,384	35,411	66,702	32,017	11,913	6,076	181,638	116,891
Utah	279	50,347	53,871	14	5,791	5,386	56,612	26,042	8,467	1,491	15	13	116,232	86,803
Wyoming	98	12,064	10,254	12	12,622	7,573	47,398	17,537	1,202	565	619	266	73,905	36,195
Total	2,151	252,516	293,549	220	155.509	136,724	387,487	205.079	209,738	108,740	28,543	17,836	1,033,793	761,928
Pacific:														
Alaska	22	4,163	6,578	4	7,119	8,400	13,976	10,482	17,117	8,559	5,987	3,053	48,362	37,072
California	6,064	580,009	800,412	879	219,622	221,818	641,929	442,931	292,808	184,469	9,366	5,339	1,743,734	1,654,969
Oregon	230	21,900	43,800	29	18,401	22,916	55,183	49,118	266	207	--	--	90,750	116,036
Washington	301	35,525	62,879	40	32,360	43,686	108,464	87,856	--	--	861	534	177,210	194,955
Total	6,617	641,597	918,669	452	272,502	296,820	819,552	590,382	310,191	193,235	16,214	8,926	2,060,056	2,003,032
Total United States	41,509	4,786,128	6,964,449	3,480	2,262,909	2,535,846	3,305,979	5,594,577	3,429,231	1,748,208	292,708	204,918	19,076,955	17,047,998

[1] Includes refinery fuel use of 1,040,057 million cubic feet and 40,130 million cubic feet for carbon black production.
[2] Includes deliveries to municipalities and public authorities for institutional heating, street lighting, etc.
NOTE.—All quantities at pressure base of 14.73 psia.

Source: Federal Power Commission.

Table 10.—Production of natural gas liquids at natural gas processing plants, and disposition of residue gas in the United States in 1973–74, by State

(Million cubic feet at 14.73 psia at 60° F unless otherwise stated)

State	Total natural gas liquids and ethane production (thousand barrels)	Natural gas processed	Extraction loss (shrinkage)	Disposition of residue gas: Used at plants	Returned to formation	Vented and flared	Shipped to transmission companies	Direct deliveries to consumers	Unaccounted for	Total
1973										
Arkansas	653	26,135	1,118	2,513	194	8	20,030	2,618	—346	25,017
California	r 12,194	r 276,385	r 17,498	r 19,563	r 131,636	--	r 71,949	r 33,420	r 2,319	r 258,887
Colorado	3,402	110,662	4,674	3,107	4,145	109	98,747	--	—120	105,988
Florida, Pennsylvania, West Virginia	8,554	375,090	12,385	4,391	11	--	357,722	581	--	362,705
Illinois and Kentucky	12,473	358,142	18,975	2,793	--	--	333,518	2,681	175	339,167
Kansas	30,456	1,503,660	43,909	9,746	1,678	65	1,366,017	82,363	—118	1,459,751
Louisiana	150,607	6,524,729	206,833	108,812	130,323	2,863	5,213,818	866,070	—3,990	6,317,896
Michigan	1,063	37,384	1,581	1,295	1,778	61	32,743	--	—74	35,803
Mississippi and Alabama	717	29,081	1,077	1,590	3,605	--	20,746	1,991	72	28,004
Montana, Utah, Alaska	r 3,823	r 140,416	r 5,393	r 6,175	r 92,070	r 1,819	r 29,871	r 6,906	r —1,818	r 135,023
Nebraska, North Dakota, South Dakota	2,246	33,369	3,443	3,305	6,266	87	19,858	--	410	29,926
New Mexico	39,500	1,101,341	55,782	48,582	4,764	3,178	860,318	122,409	6,318	1,045,559
Oklahoma	43,718	1,175,548	61,647	49,710	77,372	1,078	897,361	84,793	3,587	1,113,901
Texas	314,429	7,683,830	466,143	299,738	823,369	7,671	5,279,049	748,629	59,231	7,217,687
Wyoming	10,588	303,519	16,093	10,386	10,946	576	257,539	8,722	—743	287,426
Total	634,423	19,679,291	916,551	571,706	1,288,157	17,515	14,859,281	1,961,183	64,898	18,762,740
1974										
Arkansas	617	19,784	952	2,471	187	--	14,323	1,722	179	18,832
California	10,804	252,402	17,201	20,343	129,332	159	58,564	24,118	2,685	235,201
Colorado	4,154	118,686	6,210	4,612	4,949	487	100,748	1,364	316	112,476
Florida, Pennsylvania, West Virginia	8,810	409,248	13,049	4,720	8	--	391,108	363	--	396,199
Illinois and Kentucky	12,628	342,046	19,378	4,319	--	--	316,163	1,984	202	322,668
Kansas	31,032	1,407,239	43,416	10,165	1,742	159	1,301,549	50,149	59	1,363,823
Louisiana	144,299	6,273,136	194,329	103,973	102,858	1,510	5,169,920	704,324	—3,778	6,078,807
Michigan	1,315	45,106	1,921	1,713	1,994	38	39,708	--	—268	43,185
Mississippi and Alabama	784	24,568	1,180	1,638	3,070	67	13,899	4,532	182	23,388
Montana, Utah, Alaska	4,018	146,907	5,912	6,071	92,638	1,416	28,916	9,192	2,762	140,995
Nebraska, North Dakota, South Dakota	2,032	34,243	3,031	3,182	7,267	66	20,454	--	243	31,212
New Mexico	39,984	1,060,491	54,986	49,981	4,489	2,902	846,035	97,612	4,486	1,005,505
Oklahoma	43,812	1,092,487	62,860	51,138	72,012	897	823,053	77,391	5,136	1,029,627
Texas	302,072	7,194,453	448,993	289,419	721,678	9,219	4,962,687	709,383	53,074	6,745,460
Wyoming	9,737	263,684	14,072	9,497	8,997	391	224,561	6,478	—312	249,612
Total	616,098	18,684,480	887,490	563,242	1,151,171	17,261	14,811,688	1,688,612	65,016	17,796,990

r Revised.

Table 11.—Comparison of actual firm requirements and firm curtailments for year April 1974 through March 1975 with projections for year April 1975 through March 1976

(Million cubic feet)

	Total for year April 1974–March 1975			Total for year April 1975–March 1976		
	Actual			Projected		
	Firm requirements [1]	Volume curtailed	Percent curtailed	Firm requirements [1]	Deficiency	Percent deficient
Alabama-Tennessee Natural Gas Co	28,638	3,272	11.43	31,814	8,200	26.19
Algonquin Gas Transmission Co	150,932	13,222	8.76	152,220	20,364	13.38
Arkansas Louisiana Gas Co	528,666	156,567	29.62	511,544	153,183	29.95
Bluefield Gas Co	1,215	144	11.85	1,048	--	--
Cities Service Gas Co	586,121	100,179	17.09	577,808	149,375	25.85
Colorado Interstate Gas Co	361,212	--	--	381,729	13,660	3.58
Columbia Gas Transmission Corp	1,456,315	188,186	12.92	1,468,050	408,966	27.86
Commericial Pipeline Co. Inc	496	--	--	509	--	--
Consolidated Gas Supply Corp	720,894	9,001	1.25	784,214	45,729	5.83
East Tennessee Natural Gas Corp	77,057	9,942	12.90	79,434	28,359	35.70
Eastern Shore Natural Gas Co	6,315	836	13.24	6,566	2,156	32.84
El Paso Natural Gas Co	1,433,808	183,059	12.77	1,417,835	278,175	19.62
Florida Gas Transmission Co	31,565	--	--	35,214	--	--
Grand Gas Corp	(2)	(2)	(2)	(2)	(2)	(2)
Granite State Gas Transmission, Inc	4,043	--	--	8,962	--	--
Great Lakes Gas Transmission Co	88,841	--	--	86,741	--	--
Kansas-Nebraska Natural Gas Co. Inc	87,288	--	--	85,985	--	--
Kentucky-West Virginia Gas Co	24,460	--	--	27,696	--	--
Lawrenceburg Gas Transmission Corp	5,371	--	--	5,523	--	--
Louisiana-Nevada Transit Co	4,930	429	8.70	4,691	376	8.02
McCulloch Interstate Gas Corp	13,014	--	--	12,966	--	--
Michigan Wisconsin Pipe Line Co	940,787	--	--	963,808	29,400	3.05
Mid Louisiana Gas Co	29,885	2,040	6.83	30,644	4,818	15.72
Midwestern Gas Transmission Co	348,161	17,219	4.95	350,052	29,589	8.45
Mississippi River Transmission Corp	219,954	517	.24	221,989	2,649	1.19
Montana-Dakota Utilities Co	37,213	--	--	38,013	--	--
National Fuel Gas Supply Corp	169,421	648	.38	214,864	5,198	2.42
Natural Gas Pipeline Co of America	1,409,294	208,511	14.80	1,429,748	206,492	14.44
North Penn Gas Co	28,475	--	--	29,587	1,258	4.25
Northern Natural Gas Co	870,500	22,737	2.61	794,871	19,450	2.45
Northwest Pipeline Corp	436,434	34,516	7.91	472,045	33,098	7.01
Ohio River Pipeline Corp	8,472	37	.44	8,707	259	2.97
Pacific Gas Transmission Co	301,000	--	--	304,738	--	--
Panhandle Eastern Pipe Line Co	730,979	81,598	11.16	735,436	145,024	19.72
South Georgia Natural Gas Co	11,635	47	.40	14,837	27	.18
Southern Natural Gas Co	600,292	2,571	.43	602,027	--	--
Tennessee Gas Pipeline Co., a division of Tenneco, Inc	[3] 1,300,320	112,279	8.63	1,325,252	170,830	12.89
Tennessee Natural Gas Lines, Inc	26,629	--	--	29,650	--	--
Texas Eastern Transmission Corp	1,084,460	232,615	21.45	1,084,365	278,921	25.72
Texas Gas Pipe Line Corp	4,033	--	--	3,650	--	--
Texas Gas Transmission Corp	774,140	34,123	4.40	771,141	140,360	18.20
Transcontinental Gas Pipe Line Corp	1,047,630	290,161	27.70	1,059,488	429,380	40.53

See footnotes at end of table.

Table 11.—Comparison of actual firm requirements and firm curtailments for year April 1974 through March 1975 with projections for year April 1975 through March 1976—Continued

(Million cubic feet)

	Total for year April 1974–March 1975			Total for year April 1975–March 1976		
	Actual			Projected		
	Firm requirements[1]	Volume curtailed	Percent curtailed	Firm requirements[1]	Deficiency	Percent deficient
Transwestern Pipeline Co	425,845	59,236	13.91	461,037	94,423	20.48
Trunkline Gas Co	593,306	233,351	39.33	595,504	277,237	46.56
United Gas Pipe Line Co	1,572,523	651,339	41.42	1,610,737	767,536	47.65
West Texas Gathering Co	91,721	--	--	91,500	--	--
Western Gas Interstate Co	7,520	--	--	9,204	13	.14
Western Transmission Corp	1,738	--	--	2,248	--	--
Total	18,683,543	2,648,382	14.20	18,932,131	3,744,519	19.78
Net requirements[4]	14,825,477	XX	XX	15,042,061	XX	XX
Net curtailments[5]	XX	2,016,132	XX	XX	2,916,965	XX
Net curtailments as a percent of net requirements	XX	XX	13.58	XX	XX	19.39

XX Not applicable.

[1] Requirement volumes reported in the Apr. 30, 1975, Form 16's have been adjusted to eliminate volumes transported for others and exchanged with others.

[2] Grand Gas Corp. reported all volumes are sold to Northwest Pipeline Corp. It reported no curtailments.

[3] Sales deliveries were added to curtailments to obtain requirements.

[4] After elimination of pipeline-to-pipeline requirements.

[5] After elimination of pipeline-to-pipeline curtailments.

Source: Federal Power Commission.

Table 12.—Comparison of actual and firm requirements and firm curtailments for heating season November 1974 through March 1975 with projections for year November 1975 through March 1976

(Million cubic feet)

	Heating season November 1974–March 1975			Heating season November 1975–March 1976		
	Actual			Projected		
	Firm requirements [1]	Volume curtailed	Percent curtailed	Firm requirements [1]	Deficiency	Percent deficient
Alabama-Tennessee Natural Gas Co	11,814	3,272	27.70	15,927	5,183	32.54
Algonquin Gas Transmission Co	88,877	12,367	13.91	92,702	14,711	15.87
Arkansas Louisiana Gas Co	243,844	78,185	32.06	235,401	66,708	28.34
Bluefield Gas Co	753	41	5.44	750	--	--
Cities Service Gas Co	302,264	74,874	24.77	299,405	81,423	27.19
Colorado Interstate Gas Co	189,784	--	--	203,024	13,600	6.70
Columbia Gas Transmission Corp	850,389	181,852	21.38	848,726	235,177	27.71
Commercial Pipeline Co. Inc	329	--	--	345	--	--
Consolidated Gas Supply Corp	383,443	9,001	2.35	431,900	18,979	4.39
East Tennessee Natural Gas Corp	38,744	9,942	25.66	39,611	13,348	33.69
Eastern Shore Natural Gas Co	3,089	806	26.09	3,361	1,644	48.91
El Paso Natural Gas Co	606,284	103,239	17.03	605,814	148,568	24.52
Florida Gas Transmission Co	16,218	--	--	19,965	--	--
Grand Gas Corp	(2)	(2)	(2)	(2)	(2)	(2)
Granite State Gas Transmission, Inc	2,169	--	--	2,356	--	--
Great Lakes Gas Transmission Co	36,846	--	--	37,063	--	--
Kansas-Nebraska Natural Gas Co., Inc	41,135	--	--	41,395	--	--
Kentucky-West Virginia Gas Co.	9,170	--	--	11,887	--	--
Lawrenceburg Gas Transmission Corp	2,195	--	--	2,299	642	27.93
Louisiana-Nevada Transit Co	2,236	372	16.64	2,363	369	15.62
McCulloch Interstate Gas Corp	5,162	--	--	5,036	--	--
Michigan Wisconsin Pipe Line Co	494,392	--	--	505,022	17,000	3.37
Mid Louisiana Gas Co	14,400	1,510	10.49	15,461	2,097	13.56
Midwestern Gas Transmission Co	149,985	16,149	10.77	150,900	13,695	9.08
Mississippi River Transmission Corp	131,614	390	.30	131,698	997	.76
Montana-Dakota Utilities Co	25,301	--	--	25,852	--	--
National Fuel Gas Supply Corp	128,249	648	.51	139,612	5,196	3.72
Natural Gas Pipeline Co. of America	507,115	--	--	526,616	--	--
North Penn Gas Co	15,739	--	--	17,499	1,258	7.19
Northern Natural Gas Co	323,267	18,315	5.67	392,944	18,050	4.59
Northwest Pipeline Corp	215,460	34,093	15.82	215,822	32,384	15.00
Ohio River Pipeline Corp	5,383	37	.69	5,649	259	4.58
Pacific Gas Transmission Co	137,206	--	--	130,735	--	--
Panhandle Eastern Pipe Line Co	357,647	60,587	16.94	360,975	85,646	23.73
South Georgia Natural Gas Co	5,088	--	--	8,415	27	.32
Southern Natural Gas Co	273,629	70	.03	282,298	--	--
Tennessee Gas Pipeline Co., a division of Tenneco, Inc	[3] 578,548	83,677	14.46	[3] 592,035	70,189	11.85
Tennessee Natural Gas Lines, Inc	14,269	--	--	16,231	--	--
Texas Eastern Transmission Corp	480,422	98,536	20.51	501,870	117,491	23.43
Texas Gas Pipe Line Corp	1,332	--	--	1,484	--	--
Texas Gas Transmission Corp	339,306	14,179	4.18	353,408	44,987	12.73
Transcontinental Gas Pipe Line Corp	480,452	123,523	25.71	496,700	180,426	36.32
Transwestern Pipeline Co	180,040	28,707	15.94	194,905	43,572	22.36
Trunkline Gas Co	247,027	103,743	42.00	249,312	120,483	48.33
United Gas Pipe Line Co	676,927	265,454	39.21	709,971	320,182	45.10
West Texas Gathering Co	37,259	--	--	36,785	--	--
Western Gas Interstate Co	3,468	--	--	3,355	--	--
Western Transmission Corp	835	--	--	923	--	--
Total	8,664,550	1,323,569	15.28	8,965,302	1,674,288	18.67
Net curtailments [4]	XX	1,019,203	XX	XX	1,326,733	XX

XX Not applicable.

[1] Requirement volumes reported in the Apr. 30, 1975 Form 16's have been adjusted to eliminate volumes transported for others and volumes exchanged with others.

[2] Reported all sales to Northwest Pipeline Corp. and no curtailments.

[3] Sales dellIveries were added to curtailments to obtain requirements.

[4] After elimination of pipeline-to-pipeline curtailments.

Source: Federal Power Commission.

Table 13.—Comparison of actual interruptible sales and curtailments for year April 1974 through March 1975 with projected requirements and deficiencies for year April 1975 through March 1976

(Million cubic feet)

	Actual—year April 1974–March 1975			Projected—year April 1975–March 1976		
	Interruptible requirement	Volume curtailed	Percent curtailed	Interruptible requirement	Volume deficiency	Percent deficient
Alabama-Tennessee Natural Gas Co	11,050	3,335	30.18	11,504	8,938	77.69
Algonquin Gas Transmission Co	13,604	13,604	100.00	11,638	11,638	100.00
Arkansas Louisiana Gas Co	19,842	19,842	100.00	23,848	23,848	100.00
Bluefield Gas Co	46	46	100.00	194	106	54.64
Colorado Interstate Gas Co	50,449	17,905	35.46	52,520	24,263	46.20
East Tennessee Natural Gas Corp	21,764	9,638	44.28	22,002	20,656	93.88
Eastern Shore Natural Gas Co	1,803	1,723	95.56	1,714	1,714	100.00
Florida Gas Transmission Co	120,193	29,642	24.66	104,334	50,259	48.17
Granite State Gas Transmission, Inc	331	190	57.40	319	74	23.20
Kansas-Nebraska Natural Gas Co., Inc	30,425	2,185	7.18	31,517	4,900	15.55
Louisiana-Nevada Transit Co	1,510	7	.46	114	38	33.33
Mississippi River Transmission Corp	7,760	--	--	--	--	--
Montana-Dakota Utilities Co	19,473	--	--	20,195	--	--
Northern Natural Gas Co	9,333	--	--	1,470	--	--
Northwest Pipeline Corp	20,787	9,531	45.85	23,395	20,417	87.27
Ohio River Pipeline Corp	2,044	965	47.21	2,408	2,408	100.00
Panhandle Eastern Pipe Line Co.[1]	71,042	23,758	33.44	74,500	39,989	53.68
South Georgia Natural Gas Co	21,298	6,556	30.78	19,782	9,292	46.97
Southern Natural Gas Co	122,651	68,778	56.08	109,022	80,416	73.76
Tennessee Natural Gas Lines, Inc	12,553	8,916	71.03	17,182	8,591	50.00
Texas Gas Transmission Corp	4,080	3,107	76.15	4,080	4,072	99.80
Transwestern Pipeline Co	950	--	--	950	--	--
Total	562,988	219,728	39.03	532,688	311,619	58.50
Net requirement;[2] net curtailments[3]	535,000	195,870	36.61	503,277	283,343	56.30

[1] After elimination of pipeline-to-pipeline requirements.
[2] After elimination of pipeline-to-pipeline curtailments.
[3] Reflects revised Form 16 filed by Panhandle.

Source: Federal Power Commission.

Table 14.—Marketed production, interstate shipments and total consumption of natural gas in the United States, 1974

(Million cubic feet)

Region and State	Marketed production	Interstate movements: Receipts	Interstate movements: Deliveries	Interstate movements: Net receipts (+) or deliveries (—)	Change in underground storage	Transmission loss and unaccounted for	Consumption
New England:							
Connecticut	--	160,854	94,299	66,555	—501	713	66,348
Maine, New Hampshire, Vermont	--	17,260	1,934	15,326	--	629	14,697
Massachusetts	--	182,472	26,779	155,693	—1,707	2,132	155,268
Rhode Island	--	99,154	75,696	23,458	—411	88	23,781
Total	--	459,740	198,708	261,032	—2,619	3,562	260,089
Middle Atlantic:							
New Jersey	--	700,511	426,406	274,105	624	—1,569	275,050
New York	4,990	888,738	256,725	632,013	2,691	6,819	627,493
Pennsylvania	82,637	1,776,519	1,181,508	595,011	—40,647	2,672	715,623
Total	87,627	3,365,768	1,864,639	1,501,129	—37,332	7,922	1,618,166
East North Central:							
Illinois	1,436	2,213,790	991,334	1,222,456	47,744	12,933	1,163,215
Indiana	176	1,967,486	1,435,665	531,821	—1,218	1,343	531,872
Michigan	69,133	869,059	13,232	855,827	—17,316	4,312	937,964
Ohio	92,055	2,778,124	1,794,255	983,869	—26,410	15,683	1,086,651
Wisconsin	--	465,509	79,739	385,770	—331	4,953	381,148
Total	162,800	8,293,968	4,314,225	3,979,743	2,469	39,224	4,100,850
West North Central:							
Iowa	--	1,379,323	995,699	383,624	12,391	3,638	367,595
Kansas	886,782	2,100,454	2,345,003	—244,549	8,487	3,317	630,429
Minnesota	--	577,358	223,040	354,318	523	2,151	351,644
Missouri	33	1,603,047	1,184,299	418,748	1,188	7,709	409,884
Nebraska	2,538	1,373,156	1,149,267	223,889	5,304	—2,144	223,267
North Dakota	31,206	16,053	6,301	9,752	--	2,928	38,030
South Dakota	--	34,107	1,901	32,206	--	130	32,076
Total	920,559	7,083,498	5,905,510	1,177,988	27,893	17,729	2,052,925
South Atlantic:							
Delaware	--	22,193	1,457	20,736	--	371	20,365
Florida	38,137	255,493	--	255,493	--	710	292,920
Georgia	--	1,227,583	892,111	335,472	90	5,043	330,339
Maryland and District of Columbia	133	752,816	548,930	203,886	1,292	3,396	199,331
North Carolina	--	732,669	589,735	142,934	143	2,574	140,217
South Carolina	--	869,771	732,669	137,102	27	5,064	131,991
Virginia	7,096	889,360	747,850	141,510	—146	5,102	143,650

See footnotes at end of table.

Table 14.—Marketed production, interstate shipments and total consumption of natural gas in the United States, 1974—Continued

(Million cubic feet)

Region and State	Marketed production	Interstate movements			Change in underground storage	Transmission loss and unaccounted for	Consumption
		Receipts	Deliveries	Net receipts (+) or deliveries (—)			
South Atlantic—Continued							
West Virginia	202,306	1,295,565	1,300,577	—5,012	—17,007	22,326	191,975
Total	247,672	6,045,450	4,813,329	1,232,121	—15,601	44,606	1,450,788
East South Central:							
Alabama	27,865	2,927,510	2,673,216	254,294	—211	7,108	275,262
Kentucky	71,876	3,854,479	3,684,235	170,244	1,856	6,704	233,560
Mississippi	78,787	6,064,296	5,858,875	205,421	30	7,300	276,878
Tennessee	17	4,127,109	3,863,265	263,844	946	2,744	260,171
Total	178,545	16,973,394	16,079,591	893,803	2,621	23,856	1,045,871
West South Central:							
Arkansas	128,975	2,421,412	2,249,394	172,018	335	4,318	291,345
Louisiana	7,753,631	972,873	6,499,158	—5,526,285	2,820	21,833	2,202,693
Oklahoma	1,638,942	1,451,639	2,367,371	—915,732	—8,279	8,619	722,870
Texas	8,170,798	536,614	3,766,251	—3,229,637	—604	29,264	4,912,481
Total	17,687.346	5,382,538	14,882,174	—9,499,636	—5,728	64,049	8,129,389
Mountain:							
Arizona	224	1,491,149	1,295,365	195,784	--	3,562	192,446
Colorado	144,629	295,181	118,486	176,695	—910	2,968	319,266
Idaho	--	506,879	453,673	53,206	112	37	53 057
Montana	54,873	71,045	25,214	45,831	5,444	14,494	80,766
Nevada	--	64,593	--	64,593	--	1,155	63,438
New Mexico	1,244,779	784,918	1,700,380	—915,462	12,531	4,364	312,422
Utah	50,522	238,164	161,740	76,424	682	1,291	124,973
Wyoming	326,657	97,006	296,797	—199,791	—1,174	18,222	109,818
Total	1,821.684	3,548,935	4,051,655	—502,720	16,685	46,093	1,256,186
Pacific:							
Alaska	128,935	--	50,258	—50,258	13,253	1,453	63,971
California	365,354	1,598,378	--	1,598,378	79,534	32,584	1,851,614
Oregon	--	464,072	359,991	104,081	5	6,025	98,051
Washington	--	664,700	477,866	186,834	2,483	1,628	182,723
Total	494,289	2,727,150	888,115	1.839.035	95,275	41,690	2,196,359
Total United States	21,600,522	[1]53,880,441	[2]52,997,946	882,495	83,663	288,731	22,110,623

[1] Includes receipts from Canada of 405,499 MMcf into Idaho; 238,905 MMcf into Washington; 256,100 MMcf into Minnesota; 48,111 MMcf into Montana; 5,556 MMcf into New York; 4,891 MMcf into Vermont; and from Mexico 222 MMcf into Texas.

[2] Includes deliveries to Canada of 13,232 MMcf from Michigan; 31 MMcf from Montana and into Mexico 9,051 MMcf from Texas; 4,217 MMcf from Arizona; and liquefied natural gas exports of 50,258 MMcf to Japan from Alaska.

Table 15.—Net interstate pipeline movements of natural gas in the United States
(Billion cubic feet at 14.73 psia)

Region and State	Net receipts from: Within region: State	Quantity	Outside region: State	Quantity	Net deliveries to: Within region: State	Quantity	Outside region: State	Quantity	Net receipts (+) and deliveries (—)
New England:									
Connecticut	Massachusetts	11.5	New York	149.4	Rhode Island	94.3	XX	XX	66.6
Maine, New Hampshire, Vermont	do	10.4	Canada	4.9	XX	XX	XX	XX	15.3
Massachusetts	Rhode Island	70.8	New York	106.8	Connecticut	11.5	XX	XX	155.7
	XX	XX	XX	XX	New Hampshire	10.4	XX	XX	
Rhode Island	Connecticut	94.3	XX	XX	Massachusetts	70.8	XX	XX	23.5
Total [1]	XX	187.0	XX	261.1	XX	187.0	XX	XX	261.0
Middle Atlantic:									
New Jersey	Pennsylvania	700.1	XX	XX	New York	426.0	XX	XX	274.1
New York	New Jersey	426.0	Canada	5.6	XX	XX	Connecticut	149.4	632.0
	Pennsylvania	456.6	XX	XX	XX	XX	Massachusetts	106.8	
Pennsylvania	XX	XX	Maryland	545.0	New Jersey	700.1	Delaware	22.2	595.0
	XX	XX	West Virginia	717.9	New York	456.6	XX	XX	
	XX	XX	Ohio	511.1	XX	XX	XX	XX	
Total	XX	1,528.7	XX	1,779.6	XX	1,582.7	XX	278.4	1,501.1
East North Central:									
Illinois	XX	XX	Iowa	663.4	Indiana	526.0	XX	XX	1,222.5
	XX	XX	Kentucky	390.9	Wisconsin	245.8	XX	XX	
	XX	XX	Missouri	939.9	XX	XX	XX	XX	
Indiana	Illinois	526.0	Kentucky	1,223.4	Ohio	1,217.7	XX	XX	581.8
Michigan	Ohio	789.3	XX	XX	XX	XX	Canada	13.2	855.8
	Wisconsin	79.7	XX	XX	XX	XX	XX	XX	
Ohio	Indiana	1,217.7	Kentucky	1,223.4	Michigan	789.3	Pennsylvania	511.1	933.9
	XX	XX	XX	XX	XX	XX	West Virginia	211.8	
Wisconsin	Illinois	245.8	Minnesota	219.7	Michigan	79.7	XX	XX	385.8
Total [1]	XX	2,858.5	XX	4,715.7	XX	2,858.5	XX	736.1	3,979.7
West North Central:									
Iowa	Missouri	242.8	XX	XX	Minnesota	320.9	Illinois	663.4	383.6
	South Dakota	11.1	XX	XX	XX	XX	XX	XX	
	Nebraska	1,136.1	XX	XX	XX	XX	XX	XX	
Kansas	XX	XX	Oklahoma	2,081.5	Missouri	946.8	Colorado	40.5	—244.5
	XX	XX	XX	XX	Nebraska	1,338.7	XX	XX	
Minnesota	Iowa	320.9	Canada	256.1	North Dakota	3.3	Wisconsin	219.7	354.3
	South Dakota	.4	XX	XX	XX	XX	XX	XX	
Missouri	Kansas	946.8	Arkansas	654.6	Iowa	242.8	Illinois	939.9	418.7
	XX	XX	Oklahoma	.2	XX	XX	XX	XX	
Nebraska	Kansas	1,338.7	Colorado	2.5	Iowa	1,136.1	XX	XX	223.9
	XX	XX	Wyoming	29.1	South Dakota	10.3	XX	XX	

See footnotes at end of table.

Table 15.—Net interstate pipeline movements of natural gas in the United States—Continued

(Billion cubic feet at 14.73 psia)

Region and State	Net receipts from: Within region: State	Quantity	Outside region: State	Quantity	Net deliveries to: Within region: State	Quantity	Outside region: State	Quantity	Net receipts (+) and deliveries (−)
West North Central—Continued									
North Dakota	Minnesota	3.3	Montana	6.5	XX	XX	XX	XX	9.8
South Dakota	Nebraska	10.3	do	11.9	Iowa	11.1	Wyoming	.7	
	XX	XX	XX	XX	Minnesota	.4	XX	XX	32.2
Total	XX	4,010.4	XX	3,042.4	XX	4,010.4	XX	1,864.2	1,178.0
South Atlantic:									
Delaware	XX	XX	Pennsylvania	22.2	Maryland	1.5	XX	XX	20.7
Florida	Georgia	7.5	Alabama	248.0	XX	XX	XX	XX	255.5
Georgia	XX	XX	do	1,227.6	Florida	7.5	Tennessee	14.8	
	XX	XX	XX	XX	South Carolina	869.8	XX	XX	335.5
Maryland and District of Columbia	Delaware	1.5	XX	XX	XX	XX	Pennsylvania	545.0	
	West Virginia	8.3	XX	XX	XX	XX	XX	XX	203.9
	Virginia	729.0	XX	XX	XX	XX	XX	XX	
North Carolina	South Carolina	782.7	XX	XX	Virginia	589.7	XX	XX	142.9
South Carolina	Georgia	869.8	XX	XX	North Carolina	782.7	XX	XX	137.1
Virginia	North Carolina	589.7	Tennessee	8.8	District of Columbia	10.1	XX	XX	
	West Virginia	282.1	XX	XX	Maryland	718.9	XX	XX	141.5
West Virginia	XX	XX	Kentucky	791.4	do	8.3	Pennsylvania	717.9	
	XX	XX	Ohio	211.8	Virginia	282.1	XX	XX	−5.0
Total	XX	3,220.6	XX	2,509.8	XX	3,220.6	XX	1,277.7	1,282.1
East South Central:									
Alabama	Mississippi	2,914.8	XX	XX	Tennessee	1,184.9	Florida	248.0	
	XX	XX	XX	XX	XX	XX	Georgia	1,227.6	254.3
Kentucky	Tennessee	3,854.5	XX	XX	XX	XX	Illinois	390.9	
	XX	XX	XX	XX	XX	XX	Indiana	1,223.4	
	XX	XX	XX	XX	XX	XX	West Virginia	791.4	170.2
	XX	XX	XX	XX	XX	XX	Ohio	1,278.4	
Mississippi	XX	XX	Arkansas	1,587.1	Alabama	2,914.8	XX	XX	
	XX	XX	Louisiana	4,460.4	Tennessee	2,927.4	XX	XX	205.4
Tennessee	Alabama	1,184.9	Georgia	14.8	Kentucky	3,854.5	Virginia	8.8	
	Mississippi	2,927.4	XX	XX	XX	XX	XX	XX	263.8
Total[1]	XX	10,881.6	XX	6,062.3	XX	10,881.6	XX	5,168.5	893.8
West South Central:									
Arkansas	Louisiana	1,702.1	XX	XX	XX	XX	Mississippi	1,587.1	
	Oklahoma	141.8	XX	XX	XX	XX	Missouri	654.6	172.0
	Texas	569.9	XX	XX	XX	XX	XX	XX	
Louisiana	do	636.2	XX	XX	Arkansas	1,702.1	Mississippi	4,460.4	−5,526.3

Oklahoma	**Texas**	1,394.4	XX	XX	**Arkansas**	141.8	Colorado	86.8	—915.7
	XX	XX	XX	XX	XX	XX	Missouri	.2	
	XX	XX	XX	XX	XX	XX	Kansas	2,081.5	
Texas	XX	XX	XX	XX	**Arkansas**	569.9	**New Mexico**	620.3	—3,229.6
	XX	XX	XX	XX	**Louisiana**	636.2	**Mexico**	8.8	
	XX	XX	XX	XX	**Oklahoma**	1,394.4	XX	XX	
Total	XX	4,444.4	XX	--	XX	4,444.4	XX	9,499.7	—9,499.6
Mountain:									
Arizona	**New Mexico**	1,484.5	XX	XX	**Nevada**	35.5	**California**	1,252.3	195.8
	Utah	3.3	XX	XX	XX	XX	**Mexico**	4.2	
Colorado	**New Mexico**	51.2	Kansas	40.5	**Utah**	100.4	**Nebraska**	2.5	176.7
	Wyoming	101.1	Oklahoma	86.8	XX	XX	XX	XX	
Idaho	**Utah**	74.9	Oregon	12.7	**Nevada**	29.1	**Washington**	410.8	53.2
	XX	XX	Canada	405.5	XX	XX	XX	XX	
Montana	**Wyoming**	16.1	do	48.1	XX	XX	**South Dakota**	11.9	45.8
	XX	XX	XX	XX	XX	XX	North Dakota	6.5	
Nevada	Idaho	29.1	XX	XX	XX	XX	XX	XX	64.6
	Arizona	35.5	XX	XX	XX	XX	XX	XX	
New Mexico	XX	XX	Texas	620.3	Arizona	1,484.5	XX	XX	—915.5
	XX	XX	XX	XX	Colorado	51.2	XX	XX	
Utah	Colorado	100.4	XX	XX	Arizona	3.3	XX	XX	76.4
	Wyoming	54.2	XX	XX	Idaho	74.9	XX	XX	
Wyoming	XX	XX	**South Dakota**	.7	Colorado	101.1	Nebraska	29.1	—199.8
	XX	XX	XX	XX	Montana	16.1	XX	XX	
	XX	XX	XX	XX	Utah	54.2	XX	XX	
Total[1]	XX	1,950.3	XX	1,214.6	XX	1,950.3	XX	1,717.3	—502.7
Pacific:									
Alaska	XX	XX	XX	XX	XX	XX	Japan	[2]50.3	—50.3
California	Oregon	346.0	**Arizona**	1,252.3	XX	XX	XX	XX	1,598.4
Oregon	Washington	462.9	XX	XX	**California**	346.0	**Idaho**	12.7	104.1
Washington	XX	XX	**Canada**	238.9	Oregon	462.9	XX	XX	186.8
	XX	XX	**Idaho**	410.8	XX	XX	XX	XX	
Total[1]	XX	808.9	XX	1,902.0	XX	808.9	XX	63.0	1,839.0
United States	XX	XX	**Canada**	945.9	XX	XX	Japan	[2]50.3	882.5
	XX	XX	XX	XX	XX	XX	**Mexico**	13.0	
Total	XX	XX	XX	945.9	XX	XX	XX	63.3	882.5

XX Not applicable.

[1] Data may not add to totals shown because of independent rounding.

[2] Liquefied natural gas.

Table 16.—Estimated total proved reserves of natural gas in the United States

(Million cubic feet at 14.73 psia at 60° F)

State	Reserves as of Dec. 31, 1973	Changes in reserves during 1974						Reserves as of Dec. 31, 1974				
		Revisions	Extensions	New field discoveries	New reservoir discoveries in old fields	Net change in underground storage [1]	Production [2]	Total gas	Non-associated	Associated-dissolved	Underground storage [3]	Net change in reserves
Alabama	327,375	62,404	133,787	716	--	--	16,912	507,870	464,760	42,610	--	179,995
Alaska	31,642,626	13,916	154,000	--	200,000	--	143,930	31,866,612	5,436,788	26,429,824	--	223,986
Arizona	4,570	−2,916	--	--	--	--	243	1,411	572	839	--	−3,159
Arkansas	2,269,353	−87,115	22,300	1,434	42,065	−10,943	123,690	2,113,404	1,934,788	155,058	23,558	−155,949
California [4]	5,199,837	134,092	106,988	34,700	23,055	52,888	356,963	5,194,592	2,273,602	2,588,435	332,555	−5,245
Colorado	1,868,299	−45,504	174,363	13,780	3,218	−676	131,785	1,881,695	1,609,917	247,421	24,357	13,396
Florida	148,914	199,346	--	87	--	--	39,481	308,866	--	308,866	--	159,952
Illinois	380,525	−388	10	--	--	22,348	3,076	399,414	1,108	20,741	377,570	18,889
Indiana	66,682	−726	--	--	--	−1,300	515	64,141	2,078	2,648	59,415	−2,541
Iowa	76,244	--	--	--	--	4,221	--	80,465	--	--	80,465	4,221
Kansas	11,722,395	605,750	262,315	13,415	1,759	−8,594	892,309	11,704,731	11,435,236	170,992	98,503	−17,664
Kentucky	864,921	107	28,301	4,876	885	4,698	59,781	844,002	683,888	42,717	117,397	−20,919
Louisiana [4]	69,151,613	−539,101	1,112,272	852,039	1,194,730	−5,321	7,713,787	64,052,445	52,929,627	10,949,026	173,792	−5,099,168
Maryland	42,754	--	500	--	--	−1,094	126	42,034	4,202		37,832	−720
Michigan	1,548,508	−56,267	--	140,240	--	−99,186	75,041	1,458,254	477,613	455,230	525,411	−90,254
Minnesota	2,675	--	--	--	--	513	--	3,188	--	--	3,188	513
Mississippi	1,178,218	−85,778	15,986	44,949	7,107	2,642	83,704	1,079,420	869,964	117,721	91,735	−98,798
Missouri	16,897	−29	--	--		841	25	17,684	45	--	17,639	787
Montana	1,092,449	−144,104	24,104	13,937	7,947	−42,072	51,001	901,260	676,749	81,272	143,239	−191,189
Nebraska	48,816	2,976	9	2,169	--	5,179	4,540	54,609	11,884	11,304	31,421	5,793
New Mexico	12,488,363	86,943	403,506	151,806	4,108	11,157	1,200,981	11,944,902	9,483,527	2,433,917	27,458	−543,461
New York	136,842	--	28,175	5,975	--	−1,470	3,976	165,546	62,191	25	103,330	28,704
North Dakota	448,184	14,219	156	1,729	16	--	31,622	432,682	6,059	426,623	--	−15,502
Ohio	1,179,391	131,322	109,081	1,724	4,268	−28,200	94,876	1,308,210	786,412	174,250	347,548	128,819
Oklahoma	14,098,735	148,190	805,452	64,212	4,697	−26,205	1,704,769	13,390,312	10,670,558	2,506,095	213,659	−708,423
Pennsylvania	1,494,381	--	135,200	1,800	2,500	−59,001	82,735	1,492,145	933,752	11,881	546,512	−2,236
South Dakota	49	--	--	205		--	41	213	--	213	--	164
Tennessee	6,724	−2,000	600	500	100	--	17	5,907	5,634	273		−817
Texas [4]	84,936,502	−1,524,894	1,882,335	587,548	594,761	6,817	7,942,352	78,540,717	55,723,891	22,672,909	143,917	−6,395,785
Utah	1,024,728	−29,487	90,170	1,020	--	1,392	56,459	1,031,409	553,738	474,629	3,042	6,681
Virginia	37,273	--	13,500	900	--	--	6,966	44,707	44,707	--		7,434
Washington	16,018	--	--	--	--	1,164	--	17,182	--	--	17,182	1,164
West Virginia	2,319,828	−335	105,334	3,675	7,930	−10,753	160,098	2,265,581	1,869,226	51,917	344,438	−54,247
Wyoming	4,109,523	−213,956	238,807	70,309	52,327	−2,454	337,169	3,917,387	3,239,711	624,754	52,922	−192,136
Total United States	249,950,207	−1,333,285	5,847,251	2,018,745	2,151,478	−178,424	21,318,470	237,132,497	162,192,222	71,002,190	3,938,085	−12,817,710
Gulf of Mexico detail:												
Louisiana	33,977,415	311,728	707,053	734,748	541,153	--	3,851,605	32,420,492	28,090,196	4,330,296		−1,556,923
Texas	2,807,893	295,595	58,878	1,928	6,395	--	243,340	2,927,349	2,783,779	143,570	--	119,456
Total Gulf of Mexico [5]	36,785,308	607,323	765,931	736,676	547,548	--	4,094,945	35,347,841	30,873,975	4,473,866	--	−1,437,467

[1] The net difference between gas stored in and gas withdrawn from underground storage reservoirs, inclusive of adjustments and native gas transferred from other reserve categories.

[2] Preliminary net production.

[3] Gas held in underground reservoirs (including native and net injected gas) for storage purposes.

[4] Includes offshore.

[5] Included with Louisiana and Texas.

Source: Committee on Natural Gas Reserves, American Gas Association.

Table 17.—Estimated daily productive capacity of natural gas in the United States

(Million cubic feet per day at 14.73 psia at 60° F)

State	Productive capacity: Non-associated	Productive capacity: Associated-dissolved	Productive capacity: Total	State	Productive capacity: Non-associated	Productive capacity: Associated-dissolved	Productive capacity: Total
Alabama	117	14	131	Ohio	206	43	249
Alaska	571	70	641	Oklahoma	6,358	1,652	8,010
Arkansas	552	35	587	Pennsylvania	237	2	239
California [1]	1,001	612	1,613	Texas [1]	20,197	4,996	25,193
Colorado	449	71	520	Utah	118	104	222
Florida	--	--	--	Virginia	18	--	18
Illinois	1	9	10	West Virginia	456	5	461
Indiana	1	1	2	Wyoming	784	310	1,094
Kansas	3,660	141	3,801	Other States [2]	1	--	1
Kentucky	178	5	183				
Louisiana [1]	21,601	2,752	24,353	Total			
Michigan	398	149	547	United States	60,091	12,220	72,311
Mississippi	252	47	299				
Montana	199	32	231	Gulf of Mexico:			
Nebraska	6	7	13	Louisiana	11,011	1,408	12,419
New Mexico	2,716	1,058	3,774	Texas	1,273	21	1,294
New York	13	--	13				
North Dakota	1	105	106	Total Gulf of			
				Mexico	12,284	1,429	13,713

[1] Includes offshore.
[2] Includes Arizona, Iowa, Maryland, Minnesota, Missouri, South Dakota, Tennessee, and Washington.

Source: Committee on Natural Gas Reserves, American Gas Association.

Table 18.—Underground storage statistics, December 31, 1974

(Million cubic feet at 14.73 psia at 60° F)

State	Number of reservoirs	Nonassociated gas	Oil and gas	Oil	Aquifer	Other	Number of wells	Total stored gas in underground reservoirs (million cubic feet)	Total reservoir capacity (million cubic feet)
Arkansas	5	5	--	--	--	--	22	11,302	42,572
California	7	3	4	--	--	--	308	209,078	416,413
Colorado	6	4	1	--	--	[1]1	65	17,962	30,016
Illinois	31	8	--	1	22	--	1,560	611,722	989,856
Indiana	27	17	--	--	10	--	882	73,148	160,652
Iowa	7	--	--	--	7	--	351	176,377	298,500
Kansas	17	17	--	--	--	--	763	90,185	121,282
Kentucky	21	15	2	--	4	--	1,181	88,044	202,305
Louisiana	6	6	--	--	--	--	132	174,888	257,297
Maryland	1	1	--	--	--	--	66	27,744	64,770
Michigan	38	34	1	1	--	[2]2	2,592	485,054	882,769
Minnesota	1	--	--	--	1	--	45	4,986	20,000
Mississippi	4	3	--	--	--	[2]1	69	76,084	109,645
Missouri	1	--	--	--	1	--	73	29,398	45,000
Montana	5	5	--	--	--	--	184	142,066	213,152
Nebraska	1	1	--	--	--	--	15	28,053	39,270
New Mexico	2	1	--	--	1	--	42	19,807	57,274
New York	18	17	--	--	--	1	788	99,889	141,658
Ohio	22	22	--	--	--	--	3,098	349,918	505,156
Oklahoma	12	11	1	--	--	--	221	225,657	332,189
Pennsylvania	68	68	--	--	--	--	2,081	557,158	728,110
Texas	18	7	5	6	--	--	182	98,271	190,892
Utah	2	--	--	--	2	--	12	3,750	3,774
Washington	2	--	--	--	2	--	64	20,894	21,706
West Virginia	36	35	1	--	--	--	1,284	362,748	452,407
Wyoming	9	8	--	--	1	--	25	40,584	37,191
Total	367	288	15	8	51	5	15,950	3,968,754	6,368,801

[1] Coal.
[2] Salt.

Source: American Gas Association.

Table 19.—Natural gas stored in and withdrawal statistics

(Million cubic feet at 14.73 psia)

State	1973 Total stored	1973 Total withdrawn	1973 Net stored	1974 Total stored	1974 Total withdrawn	1974 Net stored
Alabama	1,070	516	554	410	621	—211
Alaska	16,327	--	16,327	13,253	--	13,253
Arkansas	2,218	1,632	586	1,783	1,448	335
California	92,331	65,516	26,815	129,945	50,411	79,534
Colorado	10,673	5,383	5,290	11,444	12,354	—910
Connecticut	683	441	242	740	1,241	—501
Delaware	255	--	255	--	--	--
Georgia	--	--	--	123	33	90
Idaho	--	--	--	112	--	112
Illinois	233,112	158,590	74,522	232,284	184,540	47,744
Indiana	46,617	32,466	14,151	36,070	37,288	—1,218
Iowa	57,011	40,352	16,659	56,505	44,114	12,391
Kansas	42,910	33,258	9,652	45,642	37,155	8,487
Kentucky	54,392	38,147	16,245	50,903	49,047	1,856
Louisiana	151,287	66,376	84,911	81,960	79,140	2,820
Maryland	11,328	12,229	—901	11,016	9,724	1,292
Massachusetts	413	2,881	—2,468	403	2,110	—1,707
Michigan	299,766	268,071	31,695	287,776	305,092	—17,316
Minnesota	829	298	531	1,502	979	523
Mississippi	29,089	22,601	6,488	25,439	25,409	30
Missouri	10,847	9,730	1,117	9,413	8,225	1,188
Montana	16,969	12,404	4,565	19,791	14,347	5,444
Nebraska	5,280	2,128	3,152	5,667	363	5,304
New Jersey	1,867	1,463	404	3,953	3,329	624
New Mexico	5,067	2,024	3,043	12,589	58	12,531
New York	40,277	39,117	1,160	56,403	53,712	2,691
North Carolina	97	--	97	2,626	2,483	143
Ohio	179,078	153,667	25,411	152,580	178,990	—26,410
Oklahoma	88,000	65,798	22,202	70,076	78,355	—8,279
Oregon	189	--	189	5	--	5
Pennsylvania	321,757	277,187	44,570	265,901	306,548	—40,647
Rhode Island	97	91	6	243	654	—411
South Carolina	48	42	6	80	53	27
Tennessee	1,606	26	1,580	1,750	804	946
Texas	46,592	45,188	1,404	54,705	55,309	—604
Utah	2,320	693	1,627	999	317	682
Virginia	320	137	183	112	258	—146
Washington	8,598	5,680	2,918	7,993	5,510	2,483
West Virginia	184,984	161,474	23,510	124,988	141,995	—17,007
Wisconsin	166	--	166	--	331	—331
Wyoming	9,854	7,214	2,640	7,025	8,199	—1,174
Total	1,974,324	1,532,820	441,504	1,784,209	1,700,546	83,663

Table 20.—Average wholesale prices for 14 large cities and adjacent areas

(Cents per Mcf)

Standard metropolitan statistical area	July 1, 1969	July 1, 1970	July 1, 1971	July 1, 1972[1]	July 1, 1973[1]	July 1, 1974[1]	July 1, 1975[1]
Baltimore	41.98	43.98	52.60	53.22	54.51	65.21	96.40
Boston	63.64	65.76	76.17	76.73	83.61	114.10	140.17
Chicago	29.63	31.93	36.04	36.65	44.76	55.66	72.68
Cleveland	40.50	44.64	49.09	52.90	52.14	62.72	73.72
Detroit	33.82	39.91	41.48	47.34	51.21	58.51	82.14
Los Angeles[2]	31.60	34.63	33.78	40.74	42.25	50.53	74.57
Minneapolis-St. Paul	36.29	36.80	42.59	45.14	52.03	55.67	67.93
Newark (and New Jersey suburbs of New York)	43.90	43.45	47.18	53.61	56.91	77.02	97.84
New York	41.52	42.51	45.98	51.93	54.17	71.64	93.78
Philadelphia	43.20	43.42	46.90	53.28	56.64	76.53	95.80
Pittsburgh	33.37	43.44	49.78	49.26	48.24	65.07	75.30
St. Louis (Missouri portion only)	33.77	37.26	47.62	49.37	53.96	61.18	90.28
San Francisco-Oakland[2]	30.81	33.67	35.17	36.52	39.24	49.01	94.27
Washington D.C	47.13	51.06	61.64	60.29	59.74	71.60	103.51

[1] Reflects contingent rates in effect subject to subsequent reduction and refunds as of July 1, of year indicated.

[2] Deliveries are not at city gates. Distributors must transport from State lines (California-Oregon and California-Arizona).

Source: Federal Power Commission.

Table 21.—Average price of residential heating gas by area 1967–75

(Dollars per 10 therms)

Standard metropolitan statistical area	January 1967	January 1968	January 1969	January 1970	January 1971	January 1972	January 1973	January 1974	January 1975
Atlanta	0.824	0.824	0.824	0.824	0.824	1.009	1.107	1.117	1.218
Baltimore	1.284	1.225	1.265	1.332	1.327	1.513	1.513	1.564	2.017
Boston	1.416	1.426	1.436	1.499	1.568	1.802	1.814	2.103	2.538
Buffalo	.878	.870	.905	.932	1.028	1.218	1.228	1.461	1.854
Chicago-Northwest Indiana	.932	.944	.895	.965	1.021	1.110	1.130	1.207	1.432
Cincinnati	.757	.771	.752	.799	.812	.948	.974	.992	1.328
Cleveland	.736	.729	.732	.747	.858	.896	.938	.928	1.229
Dallas	.727	.740	.755	.847	.849	.863	.890	.888	.914
Detroit	.850	.850	.850	.866	.873	.953	.998	1.155	1.350
Houston	.767	.772	.871	.875	.928	.957	1.000	1.042	1.499
Kansas City	.575	.569	.609	.681	.669	.717	.720	.771	.929
Milwaukee	1.067	1.067	1.101	1.247	1.272	1.350	.391	1.446	1.575
Minneapolis-St. Paul	.823	.810	.851	.877	.913	.998	1.073	1.119	1.354
New York-Northeast New Jersey	1.305	1.290	1.299	1.320	1.368	1.568	1.660	1.887	2.293
Philadelphia	1.380	1.379	1.360	1.381	1.430	1.459	1.531	1.714	2.009
Pittsburgh	.796	.809	.845	.880	.970	1.018	1.064	1.144	1.418
St. Louis	.839	.838	.842	.916	.979	1.093	1.097	1.178	1.454
San Francisco-Oakland	.610	.608	.610	.622	.714	.762	.840	.920	1.291
Seattle	1.167	1.150	1.150	1.159	1.159	1.249	1.270	1.530	1.886
Washington, D.C	1.347	1.287	1.315	1.362	1.360	1.505	1.569	1.599	2.149
U.S. average	.831	.838	.844	.874	.920	1.010	1.047	1.138	1.379

Source: Bureau of Labor Statistics, Monthly release, "Release Prices and Indexes of Fuels and Electricity" table 7; U.S. average, table 2.

Table 22.—Liquefied natural gas (LNG) exports, 1974

	Exports to Japan		
	Phillips Petroleum Co. from Port Nikiski, Alaska	Marathon Oil Co. from Port Nikiski, Alaska	Total exports
Volume shipped:			
Barrels .... 42 U.S. gallons	10,011,492	4,248,761	14,260,253
Mcf equivalent @ 14.73 psia	35,331,041	14,926,528	50,257,569
Average Btu per cubic foot	1,006	1,006	1,006
Value:			
Total dollars	26,089,777	11,052,397	37,142,174
Average price .... cents per Mcf	73.84	74.05	73.90

Source: Federal Power Commission.

Table 23.—Natural gas exports via pipeline: Volume, value, and unit cost, 1973–74

Exporting companies	Point of exit	Gas volume (thousand cubic feet at 14.73 psia and 60° F)		Percent change	Value (dollars)		Average price (cents per thousand cubic feet)	
		1973	1974		1973	1974	1973	1974
EXPORTS TO CANADA								
Interstate company:								
Panhandle Eastern Pipe Line Co	Detroit River-River Rouge, Mich	14,785,650	13,231,763	−10.3	r 8,090,818	8,473,472	54.91	64.04
Intrastate company:								
The Montana Power Co	Sweetgrass, Mont	87,822	31,030	−64.7	32,993	14,262	37.57	45.96
Total Canada[1]		14,823,472	13,262,793	−10.5	r 8,123,811	8,487,734	54.80	64.00
EXPORTS TO MEXICO								
Interstate company:								
El Paso Natural Gas Co	Naco, Ariz	4,477,062	4,217,318	−5.8	2,001,249	2,431,556	44.70	57.66
Intrastate companies:								
Del Norte Natural Gas Co	El Paso, Tex	3,770,477	3,526,592	−6.5	1,916,262	2,301,608	50.82	65.26
Texas Gas Utilities Co	Eagle Pass, Tex	1,489,487	1,462,862	−1.8	589,452	1,201,992	r 39.57	82.17
Do	Laredo, Tex	3,011,513	2,953,605	−1.9	872,471	2,482,932	28.97	84.06
United Gas, Inc	do	1,250,722	1,108,075	−11.4	426,811	934,487	r 34.12	84.33
Total intrastate		9,522,199	9,051,134	−5.0	r 3,804,996	6,921,019	39.96	76.47
Total Mexico		13,999,261	13,268,452	−5.2	r 5,806,245	9,352,575	41.48	70.49
Grand total exports		28,822,733	26,531,245	−8.0	r 13,390,056	17,840,309	r 46.17	67.24

r Revised.

[1] In addition Northern Natural Gas Co. delivered 28,600,169 Mcf produced from Tiger Ridge Area, Mont., to Consolidated Natural Gas Co. at a point on the Montana-Saskatchewan border for transportation and received 28,337,785 Mcf into its line again on the Minnesota-Manitoba border, near Emerson, Manitoba.

Source: Federal Power Commission.

Table 24.—Natural gas imports via pipeline: Volume, value, and unit cost, 1973–1974

Importing companies	Point of entry	Gas volume (thousand cubic feet at 14.73 psia and 60° F)		Percent change	Value (dollars)		Average price (cents per thousand cubic feet)	
		1973	1974		1973	1974	1973	1974
IMPORTS FROM CANADA								
Interstate companies:								
Great Lakes Gas Transmission Co	Noyes, Minn	117,355,103	[1] 110,278,903	—6.0	[r] 38.436.759	46,398.380	32.75	42.07
Inter-City Minnesota Pipeline Ltd	Warroad, Minn.[2]	7,898,143	[3] 7,773,545	—1.6	[r] 3,333,704	4,562,883	42.21	58.70
Michigan Wisconsin Pipe Line Co	Noyes, Minn	18,250,000	[3] 18,250,000	--	[r] 6,232,765	7,818,419	34.15	42.84
Midwestern Gas Transmission Co	do	118,931,089	119,797,168	.7	[r] 35,745,611	49,591,646	30.06	41.40
Northwest Pipeline Corp	Summas, Wash.[4]	267,400,874	238,905,328	—10.7	[r] 96,367,807	168,949,677	36.04	70.72
Do	Eastport, Idaho[4]	50,427,625	47,841,485	—5.1	17,881,162	22,991,765	35.46	48.06
Pacific Gas Transmission Co	do	387,429,680	357,657,900	—7.7	138,524,910	198,151,071	35.75	55.40
Total interstate[5]		967.692.514	900.504.279	—6.9	[r] 336.522.718	498,468.841	34.78	55.35
Intrastate companies:								
The Montana Power Co	Whitlash, Mont	19.349.686	18.692.519	—3.4	[r] 5,377,813	9,164,840	27.79	49.03
Do	Babb, Mont	30,714,757	29,418,757	—4.2	10,084,233	15,696,321	32.83	53.35
St. Lawrence Gas Co. Inc	Massena, N. Y	5,546,469	5,556,108	.2	[r] 3,318,691	4,209,952	59.83	75.77
Vermont Gas Systems, Inc	Highgate, Vt	3,912,384	4,890,860	25.0	2,453,151	3,332,048	62.70	68.13
Total intrastate		59,523,246	58,558,244	—1.6	21,233,888	32,403,161	35.67	55.33
Total Canada		1,027,215,760	959,062,523	—6.6	[r] 357,756,606	530,867,002	34.83	55.35
IMPORTS FROM MEXICO								
Interstate company:								
Texas Eastern Transmission Corp	McAllen, Tex	1,632,007	222,432	—86.4	271,265	37,309	16.62	16.77
Grand total imports		1,028,847,767	959,284,955	—6.8	[r] 358,027,871	530,904,311	34.80	55.34

[r] Revised.

[1] In addition to this amount 293,904,669 Mcf were received from Trans-Canada Pipe Line Ltd. for transportation and 294,182,602 Mcf were redelivered to Trans-Canada at St. Clair and Sault Ste. Marie, Mich.

[2] Second port of entry is International Falls, Minn.

[3] In addition to this amount 11,878,847 Mcf were received from Trans-Canada Pipe Line Ltd. for transportation and redelivery to Trans-Canada at Baudette, Minn.

[4] Volumes and cost data include the gas imports reported by El Paso Natural Gas Co. for 1973 and the month of January 1974 after which Northwest Pipeline Corp. imported the volumes formerly imported by El Paso.

[5] In addition, Tennessee Gas Pipeline Co. exchanged 144,921 Mcf gas with Trans-Canada Pipelines Ltd. at Niagara, N.Y.

Table 25.—Natural gas: World production by country

(Million cubic feet)

Country[1]	1972		1973		1974[p]	
	Gross production[2]	Marketed production[3]	Gross production[2]	Marketed production[3]	Gross production[2]	Marketed production[3]
North America:						
Barbados	[r] 140	[r] 127	[r] [e] 140	127	[e] 140	[e] 130
Canada	3,316,153	2,913,587	3,566,650	3,119,461	3,486,983	3,037,437
Mexico	660,232	496,019	676,750	541,772	744,673	560,911
Trinidad and Tobago	[r] 104,838	[r] 67,084	113,500	64,884	127,686	58,239
United States	24,016,109	22,531,698	24,067,202	22,647,549	22,849,793	21,600,522
South America:						
Argentina	277,643	218,350	314,793	237,737	332,889	255,536
Bolivia	120,965	37,552	151,199	57,857	144,128	60,539
Brazil	43,861	[e] 8,500	41,668	[e] 8,300	52,972	[e] 10,600
Chile[4]	[r] 285,093	[r] 144,069	260,496	144,987	246,687	127,503
Colombia	115,622	[r] 65,448	113,229	65,045	116,634	65,792
Ecuador	5,828	[e] 500	12,269	[e] 1,000	12,287	[e] 1,000
Peru	64,440	[r] 31,144	64,005	34,184	69,848	31,757
Venezuela	[r] 1,625,178	[r] 367,718	1,745,702	459,986	1,689,511	475,969
Europe:						
Albania	[5] 5,280	5,280	[5] 6,710	6,710	[e] [5] 7,170	[e] 7,170
Austria	69,827	65,459	80,168	77,835	77,930	[e] 75,100
Belgium[6]	[r] [5] 1,822	[r] 1,822	[5] 1,949	1,949	[5] 2,246	2,246
Bulgaria	[5] 7,769	7,769	[5] 7,840	7,840	[e] [5] 8,000	[e] 8,000
Czechoslovakia[7]	[r] [5] 41,035	[r] 41,035	[5] 36,798	36,798	[e] [5] 35,000	[e] 35,000
Denmark[e]	984	([8])	2,191	([8])	1,084	([8])
France	386,694	260,374	387,758	261,680	392,711	269,393
Germany, East[6]	[r] [5] 178,515	[r] 178,515	[5] 247,625	247,625	[5] 293,110	293,110
Germany, West[7]	[r] 646,241	[r] 636,679	706,181	705,895	734,787	718,202
Hungary[9]	[r] [5] 144,295	[r] 144,295	[5] 169,968	169,968	[5] 178,892	178,892
Italy	[5] 501,009	501,009	[5] 540,998	540,998	[5] 539,348	539,348
Netherlands	2,063,078	2,052,443	2,501,467	2,494,687	2,956,707	2,956,671
Norway	[e] 18,200	([8])	[e] 16,759	([8])	19,700	([8])
Poland	[5] 205,636	205,636	[5] 212,840	212,840	[5] 202,564	202,564
Romania	[r] 978,670	[r] 925,522	1,032,524	975,548	1,068,493	1,004,803
Spain	[5] 141	141	[5] 114	114	[e] [5] 115	[e] 115
U.S.S.R	[e] 8,200,000	7,818,136	[e] 8,800,000	8,334,222	[e] 9,700,000	9,217,085
United Kingdom	[r] [5] 989,881	[r] 989,881	[5] 1,018,400	1,018,400	[5] 1,160,293	1,160,293
Yugoslavia	[5] 43,861	43,861	[5] 46,933	46,933	[5] 51,100	51,100
Africa:						
Algeria	[e] 350,000	119,716	[e] 360,000	167,567	[e] 385,000	211,110
Angola	31,393	[e] 2,000	[e] 36,000	[e] 2,300	[e] 37,500	[e] 2,400
Congo (Brazzaville)	[r] [5] 551	[r] 551	[5] 565	565	[5] 678	678
Egypt	[e] 25,000	[e] 2,500	30,700	[r] [e] 3,100	49,600	[e] 15,000
Gabon	[e] 12,000	1,201	[e] 14,000	1,413	[e] 19,000	1,610
Libya	496,075	275,458	562,900	335,246	425,849	[10] 345,185
Morocco	1,822	1,763	2,302	2,221	2,081	1,991
Nigeria	[r] 604,620	[r] 9,641	735,818	10,700	1,017,774	14,255
Rwanda	[5] 35	35	[e] [5] 35	[e] 35	[e] [5] 35	[e] 35
Tunisia	1,353	[r] 706	4,513	4,026	[e] 7,600	7,119
Asia:						
Afghanistan	[5] 102,200	102,200	[5] 96,585	96,585	[5] 102,412	102,412
Bahrain	63,419	[e] [11] 40,000	82,855	[11] 56,575	100,010	[11] 68,255
Bangladesh	[r] [5] 26,000	[r] 26,000	[5] 32,000	32,000	[5] 17,241	17,223
Brunei	[e] 170,000	15,997	[r] [e] 220,000	[r] [e] 170,000	243,811	176,820
Burma[12]	11,300	3,900	12,000	5,400	[e] 11,000	[e] 4,900
China, People's Republic of[e]	[r] 880,000	[r] 750,000	[r] 1,100,000	[r] 950,000	1,400,000	1,200,000
India	55,224	32,736	59,124	32.242	67,733	25.320
Indonesia	146,481	43,562	186,137	28,425	199,598	[e] 40,000
Iran	1,469,730	447,908	1,698,691	701,678	1,766,721	787,360
Iraq[e]	185,000	30,000	250,000	35,000	280,000	40,000
Israel	[5] 4,386	4,386	[5] 1,906	1,906	[5] 2,327	2,327
Japan[7]	96,768	95,677	[e] 104,000	102,558	[e] 102,000	100,540
Kuwait[13]	[r] 647,808	[r] 181,648	581,065	186,045	466,989	186,894
Malaysia (Sarawak)	[e] 35,000	3,325	[e] 35,000	3,187	[e] 31,000	[e] 2,800
Oman[e]	90,000	1,500	90,000	1,500	90,000	1,500
Pakistan	[5] 118,680	118,680	[5] 132,100	132,100	[5] 175,000	175,000
Qatar	[e] 180,000	[e] 52,000	246,185	55,828	[e] 225,000	[e] 60,000
Saudi Arabia[13]	1,126,974	98,578	[e] 1,440,000	[e] 160,000	[e] 1,570,000	[e] 219,000
Syria[e]	40,000	8,000	37,000	7,000	40,000	8,000
Taiwan	44,632	44,186	51,358	[e] 51,000	56,034	55,372
Turkey[e]	24,000	5,000	24,000	5,000	25,000	5,000
United Arab Emirates:						
Abu Dhabi[e]	412,000	45,000	520,000	55,000	570,000	65,000
Dubai[e]	44,000	12,000	[r] 63,000	17,000	69,000	19,000

See footnotes at end of table.

Table 25.—Natural gas: World production by country—Continued

(Million cubic feet)

Country [1]	1972		1973		1974 [p]	
	Gross production [2]	Marketed production [3]	Gross production [2]	Marketed production [3]	Gross production [2]	Marketed production [3]
Oceania:						
Australia	[5] 112,583	112,583	[5] 144,754	144,754	[5] 165,164	165,164
New Zealand	[r] 7,491	[r] [e] 7,116	9,389	9,293	10,429	[e] 10,380
Total	[r] 52,683,450	[r] 43,424,596	55,908,688	46,139,070	56,881,412	47,137,672

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[e] Estimate. [p] Preliminary. [r] Revised.

[1] In addition to the countries listed, Cuba and Thailand produce crude oil and presumably natural gas, but available information is inadequate to estimate output levels and the share of gross production that is classifiable as marketed.

[2] Comprises all marketed production (see footnote 3) plus gas vented, flared, reinjected for repressuring, and used to drive gas turbines (without being burned).

[3] Comprises all gas collected and utilized as a fuel or a chemical industry raw material or for gas left in fields, including gas used in oilfields and/or gasfields as a fuel by producers, even though it is not actually sold.

[4] Apparently, natural gas that is vented and/or flared is not included in reported gross production; marketed output presented here is the difference between reported gross production and reported injection into reservoirs.

[5] Gross production not reported; marketed output has been reported in lieu of a gross production estimate because the quantity flared, vented, and/or reinjected is believed to be small.

[6] Total production is obtained from coal mines.

[7] Includes output from coal mines as follows, in million cubic feet: Czechoslovakia: 1972—12,325; 1973—11,159; 1974—11,000 (estimate); West Germany: 1972—21,612; 1973—21,577; 1974—21,612 (estimate); the Netherlands: 1972—1,236; 1973—671; 1974—300 (estimate); Poland: 1972—7,840; 1973—7,628; 1974—7,400 (estimate); the United Kingdom: 1972—3,567; 1973—4,485; 1974—4,600 (estimate); and Japan: 1972—9,358; 1973—10,806: 1974—10,900 (estimate).

[8] No marketed production reported; there probably is some small field use in both Denmark and Norway, and in the case of the latter there was extraction of natural gas liquids reported in 1973 and 1974, but available information is inadequate to make reliable estimates.

[9] Available statistics, used for both gross and marketed production, comprise marketed production plus gas injected into reservoirs for repressuring, but exclude gas vented and/or flared. In 1968 (latest available figure), gas used for repressuring constituted only 0.4% of the total. Information is inadequate to make a reliable estimate of gas vented and/or flared, but it is believed to have remained small.

[10] Includes gas injected to reservoirs for repressuring.

[11] Excluding gas used for gas lift.

[12] Data are for year ending June 30 of that stated.

[13] Includes ½ of production reported for the former Kuwait-Saudi Arabia Neutral Zone.

Natural Gas Liquids

By Ronald Prehoda [1] and Leonard L. Fanelli [2]

For the second year in a row, overall production of natural gas liquids (NGL) at natural gas processing plants declined. Production in 1974 was 616 million barrels or 3% below that of 1973 (634 million barrels). This reflected primarily the decline in availability of natural gas for processing. In 1974, nearly 1 trillion cubic feet less gas was produced.

The demand for propane was approximately 5% below that of 1973, reflecting the warmer than normal winter weather that occurred across the nation. In addition consumer awareness of the need for energy conservation and resistance to higher prices contributed to the decrease in propane demand.

NGL are products obtained from natural gas processed at natural gas processing plants. Included are ethane, liquefied petroleum gases (LPG—butane, propane, and butane-propane mixtures), isobutane, and other mixed gases. Also included in the output of these plants are natural gasolines, plant condensate, and at plants equipped with fractionators, finished products such as gasoline, special naphthas, jet fuel, kerosine, distillate fuel oil, and other finished products are obtained.

Data presented in this chapter were compiled from operating reports of plants that process natural gas. Included are all NGL, except the small volume considered to be negligible in national and State totals, recovered at pipeline compressor stations and gas dehydration plants. Plant condensate is included in NGL; field separated condensate, however, is included with crude oil. Ethane and liquefied gases such as butane and propane, recovered from the crude oil refining operations, are classed as liquefied refinery gases (LRG) and reported as refined petroleum products.

The LPG industry continued to operate under the government's mandatory allocation program (initiated in 1973) administered by the Federal Energy Administration (FEA). This program seeks to assure a continuing flow of the fuel to traditional and high-priority users such as residential and commercial. Along with allocation regulations were price controls which prescribed a maximum cents per gallon gross profit margin on fuel sold to various categories of users.

On September 27, 1974, by Presidential Proclamation 4317, the President reduced the fee on imports of NGL from 30 cents per barrel to 15.5 cents per barrel. This proclamation provided for the fee to increase to 18 cents per barrel on November 1, 1974, and to 21 cents per barrel on May 1, 1975. However, Presidential Proclamation 4341, dated January 23, 1975, established a fee of 21 cents per barrel effective February 1, 1975.

Unit value of NGL increased significantly during 1974. The 1974 output of NGL was valued at $3 billion, 40% above the 1973 level. The unit value rose 71% to $5 per barrel compared with approximately $3 per barrel in 1973.

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[1] General engineer, Division of Petroleum and Natural Gas.

[2] Survey statistician, Division of Fuels Data.

Table 1.—Salient statistics of natural gas liquids in the United States
(Thousand barrels, unless otherwise noted)

	1970	1971	1972	1973	1974
Production:					
Ethane	73,434	80,524	100,691	108,220	117,791
LPG	326,177	337,110	344,045	338,813	330,155
Natural gasoline	161,274	159,732	156,450	155,880	144,129
Other [1]	45,031	40,449	37,030	31,510	24,023
Total production	605,916	617,815	638,216	634,423	616,098
Imports	21,179	38,976	63,829	85,276	77,076
Exports	9,955	9,391	11,469	9,927	9,032
Domestic demand	609,050	622,384	700,351	695,046	668,787
Value: Average at plant (dollars per bbl)	2.10	2.24	2.28	2.93	5.01
Stocks at plants, terminals and refineries	69,002	94,018	84,243	98,940	114,295

[1] Includes isopentane, plant condensate, finished gasoline, special naphtha, distillate fuel oil, kerosine, and miscellaneous.

DOMESTIC PRODUCTION

The overall production of NGL declined for the second year in a row. Total production in 1974 amounted to 616 million barrels, 3% less than the 1973 production of 634 million barrels. Output of all categories of NGL declined with the exception of ethane. Ethane registered an increase of approximately 10 million barrels or 8.8% over that for 1973. This increase reflected the continued strong demand for this product as a petrochemical feedstock primarily for ethylene manufacture.

Of the major NGL components, natural gasoline and isopentane suffered the largest declines, which exceeded the gain in ethane production. This reduction in natural gasoline and isopentane production was attributable to the reduction in demand for gasoline blending. Gasoline demand was reduced nearly 50 million barrels from 1973 levels largely by restrictions enforced by the FEA.

The following tabulation shows the quantity and percent changes between 1973 and 1974 of the major NGL groups:

	Thousand barrels	Percent
Ethane	+9,571	+8.8
LPG:		
Propane	−6,347	−3.0
Other	−2,311	−1.8
Natural gasoline and isopentane	−13,785	−8.5
Other natural gas liquids	−5,458	−21.2
Total	−18,325	−0.3

At the beginning of 1974 there were 763 natural gas processing plants in the United States,[3] 23 fewer plants than at the beginning of 1973. Throughput capacity at natural gas plants, however, increased by 1,354 million cubic feet per day to 74,614 million cubic feet per day, an increase of 1.8%. Actual throughput was 55,624 million cubic feet per day. Over 47% of the plants were located in Texas and over 16% in Louisiana. The reduction in the number of processing plants reflected the phaseout of facilities in areas where gas supplies have been depleted.

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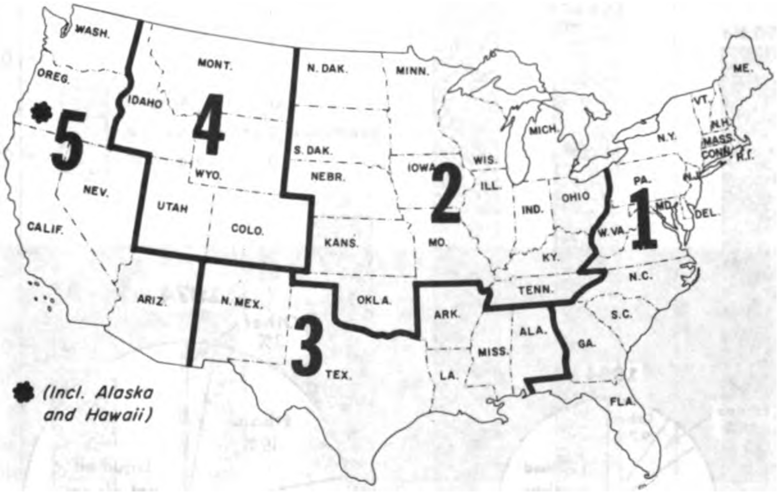
[3] Oil and Gas Journal. V. 72, No. 27, July 8, 1974, p. 80.

PETROLEUM ADMINISTRATION FOR DEFENSE (PAD) DISTRICTS



BUREAU OF MINES REFINING DISTRICTS

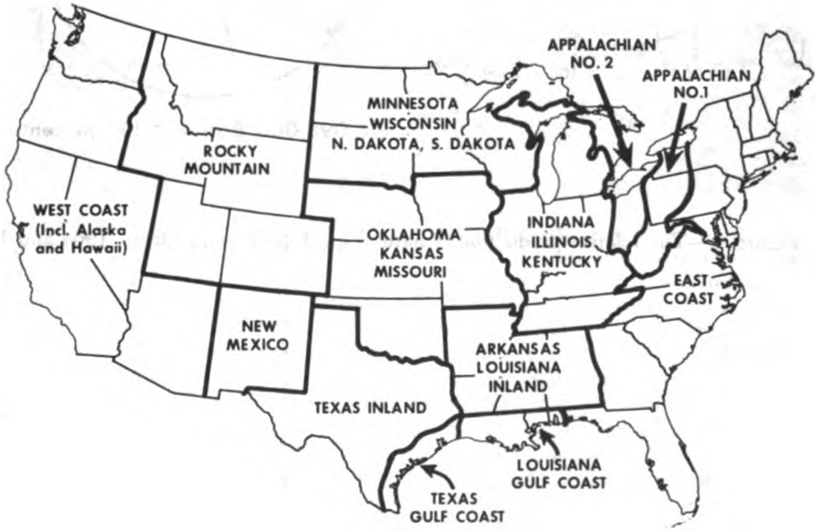


Figure 1.—Maps of PAD districts and Bureau of Mines refining districts.

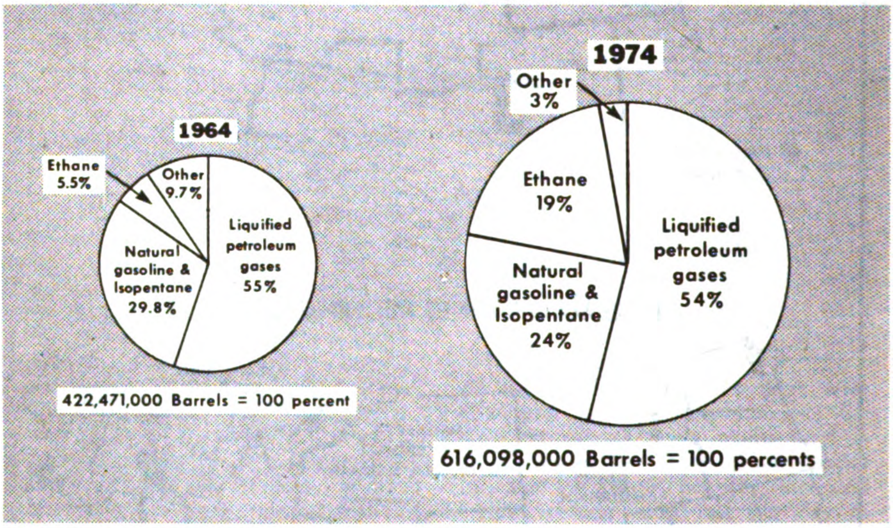


Figure 2.—The relative production of natural gas liquids components, 1964 and 1974.

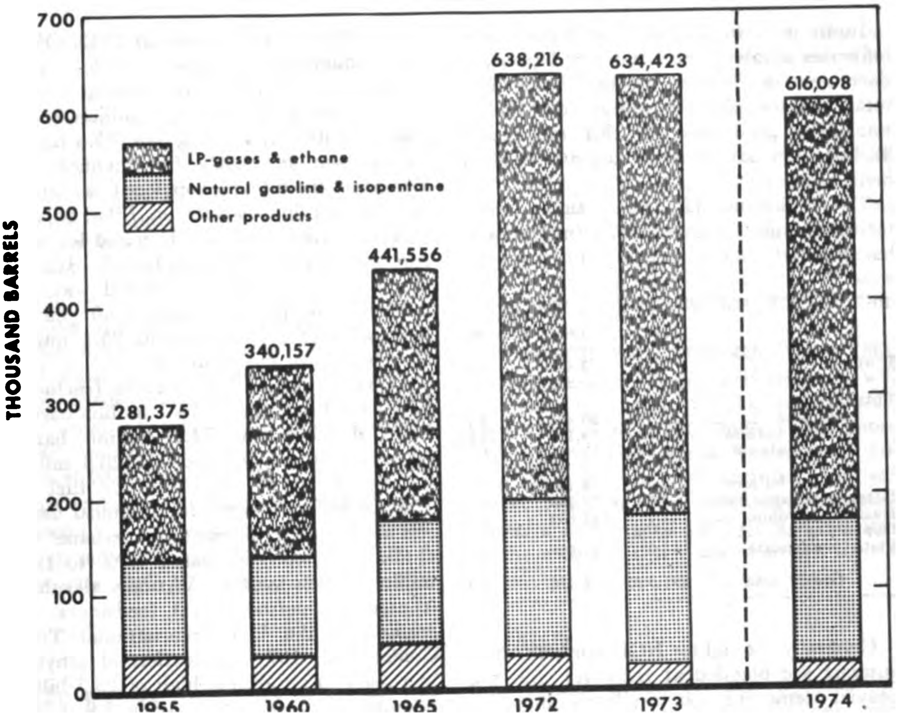


Figure 3.—Production of natural gas liquids in the United States.

RESERVES

The American Gas Association (AGA) Reserves Committee estimated that proved reserves of NGL at yearend 1974 were 6,350 million barrels. This is a decrease of 1.6% from the 1973 yearend figure of 6,455 million barrels and is the seventh consecutive year in which proved reserves declined. According to AGA data, the yearend reserve to production ratio was 8.8:1 compared with 13.4:1 in 1967 (the alltime high for proved reserves) and 8.7:1 in 1973. Only four States (Alabama, Alaska, Kansas, and Oklahoma) had net increases in proved reserves at yearend 1974. Louisiana and Texas accounted for 30% and 44%, respectively, of the total proved reserves, with significant reserves also reported in New Mexico, Kansas, and Oklahoma. Louisiana again, as last year, experienced the greatest volume reduction in reserves (110 million barrels) and also the greatest percentage decline (5.5%) among the States having major reserves.

CONSUMPTION AND USES

Input of natural gas plant liquids into refineries totaled 272.4 million barrels, a decrease of 8.4% from the 1973 level. This total run to refineries represents 44% of total NGL production. Of this total input, 32.4 million barrels were imports of plant condensate.

The following tabulation shows shipments (inputs) into refineries in thousand barrels:

	1973	1974	Percent change
Propane	2,755	3,465	+25.8
Butanes:			
Isobutane	35,723	30,829	−13.7
Normal butane	25,990	29,110	+12.0
Other butanes	11,267	13,855	+23.0
Total butane	72,980	73,794	+1.1
Butane-propane mix	4,486	2,958	−34.1
Natural gasoline	154,455	147,603	−4.4
Isopentane	5,895	--	−100.0
Plant condensate	56,911	44,596	−21.6
Grand total	297,482	272,416	−8.4

Generally the lighter NGL (propane and butane) are blended at refineries, and the heavier items are run to process units.

Domestic demand for LPG and LRG totaled 388.2 million barrels in 1974, down from 409.1 million barrels in 1973. Of the 1974 domestic demand, 269.5 million barrels was for LPG produced at natural gas processing plants, 83.2 million barrels was for LRG for fuel use and 35.6 million barrels was for LRG for chemical use. Propane (including propylene) accounted for 303 million barrels or 78% of total LPG and LRG demand. Demand for plant propane was 214.8 million barrels. Refinery propane and propylene demand was 88.2 million barrels of which 63.0 million barrels was for fuel use and 25.2 million barrels was for chemical use.

Domestic demand for butane (including butylene) decreased to 74.7 million barrels. Plant demand was 54.2 million barrels whereas refinery demand was 20.5 million barrels of which 14.1 was for fuel use and 6.4 million barrels for chemical use.

The domestic demand for ethane (including ethylene) increased 4.3% to 124.6 million barrels in 1974. Virtually all ethane is used for petrochemical feedstocks. According to the U.S. International Trade Commission, 1974 production of ethylene increased to an alltime high of 23.5 billion pounds. This compares with 5.9 billion pounds in 1960, 18.5 billion pounds in 1971, and 22.4 billion pounds in 1973.

PRODUCTIVE CAPACITY

According to AGA, estimated productive capacity at yearend 1974 was 2.4 million barrels per day, an increase of 5,000 barrels per day or 0.2% during the year. Each of the traditional leading producing States declined in productive capacity during the year except Oklahoma, which experienced a 5,000-barrel-per-day increase. Louisiana had the greatest decrease, losing 85,000 barrels per day (11% of its capacity), followed by Kansas, 14,000 barrels per day (10%); Texas, 13,000 barrels per day (1.2%); and New Mexico, 4,000 barrels per day (4%). For the first time, Florida showed a significant productive capacity of 116,000 barrels per day.

As NGL production is a function of natural gas production and processing, productive capacity is dependent upon rates of gas production from crude oil and natural gas reservoirs. AGA has defined productive capacity of NGL as the amount of hydrocarbon liquids that would be produced coincident with the estimated productive capacity of natural gas based on unit recoveries at normal producing rates. Such estimated capacities are not limited by lack of capacity of processing plants or other surface facilities, and it is emphasized that adequate facilities would be required to effect the recovery of liquids from the natural gas produced at these rates.

It should also be recognized that such facilities cannot be enlarged quickly. Therefore, the estimated NGL capacities relate to increased production of gas from oil and gas wells operating at their productive capacities, are theoretical and may not be realized in the event of an emergency.[4]

STOCKS

Stocks of NGL reached a record high of 133.2 million barrels on September 30, 1974. There were no critical drawdowns on propane stocks during the year. The lowest level for propane stocks occurred on February 28, 1974, which totaled 52.1 million barrels or 54 days of domestic propane demand. This compares with February 1973 stocks of propane which totaled 31.7 million barrels and represented only 24 days of domestic propane demand. Propane demand in February 1974 was a little more than 25% below the February 1973 demand. This building of stocks to secure levels reflects the generally warmer than usual winter weather that occurred across the nation.

Total NGL stocks at both refineries and plants and bulk terminals at yearend 1974 totaled 114.3 million barrels, or 15.4 million barrels more than at the yearend of 1973. A little over 75% of this total was in underground storage. NGL stocks at refineries amounted to 5.9 million barrels, an increase of 1.1 million barrels from stocks at yearend 1973, whereas stocks at plants and terminals totaled 108.4 million barrels or 14.3 million barrels more than at yearend 1973. By type of liquid the major yearend stock increases at plants and terminals were: Butane, up 5.4 million barrels; propane, up 5.0 million barrels; and isobutane, up 3.4 million barrels. Ethane stocks had a slight reduction of 0.5 million barrels.

As domestic propane production declines, the gap between supply and demand will be made up by increasing imports. In preparation for this, more and more companies within the LPG industry are expanding their storage facilities. For example, Petrolane Inc. completed construction of a refrigerated LPG storage terminal on the west coast, the largest in the United States.

PRICES AND VALUE

The average unit value of NGL was $5.01 per barrel, up significantly from the 1973 level of $2.93 per barrel. The sharpest increase occurred in natural gasoline and isopentane, as indicated in table 5. LPG and ethane total value accounted for 64.1% of the NGL total value. Although the volume of LPG and ethane increased less than 1%, the aggregate value of production rose some 66.7% resulting from a 66.2% increase in the unit value of LPG and ethane.

Most of this price increase occurred in LPG since there is no spot market for ethane. Also, sales of ethane are usually made under long-term contracts and therefore ethane prices do not fluctuate as widely and frequently as propane and butane prices. Propane prices for example, rose sharply during the year; the average price paid for propane in Baton Rouge, La., was 16.06 cents per gallon compared with the 1973 average price of 9.13 cents per gallon, an increase of 76%. Table 17 indicates the comparison of the monthly prices paid for propane at various locations throughout the United States.

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[4] American Gas Association, American Petroleum Institute, and Canadian Petroleum Association. Reserves of Crude Oil, Natural Gas in the United States and Canada and the United States Production Capacity as of Dec. 31, 1974.

FOREIGN TRADE

Total imports of plant condensate and LPG in 1974 amounted to 77.1 million barrels. This represents a decrease of 8.2 million barrels or 9.6% from LPG and plant condensate imports in 1973. The decline in imports reflected the general slackening in demand for LPG. Despite this reduction in imports, LPG and plant condensate imports were, on a volume basis, the third most important item of liquid hydrocarbon product imports, ranking behind residual and distillate fuel oils.

The number of countries from which the United States imported LPG dropped from 22 to 14 in 1974. Canada and Venezuela continued to lead all other countries supplying 81% and 16% respectively of total United States LPG and plant condensate imports.

Canada supplied nearly all of the plant condensate imports (98%) although these imports declined by 15% from the 1973 level.

PAD district II continued as the leading importer among the five districts, accounting for 43% of LPG imports. Imports into district I declined by 2.6 million barrels or 30% from the 1973 level.

Mexico continued as the leading importer, receiving over 98% of all LPG exported from the United States. Total LPG exports amounted to about 9 million barrels, a decline of 9.0% from 1973. However, value of LPG exports rose 62% to $92.7 million reflecting the increased price of LPG.

As indicated in table 19, Japan's total imports of propane from the United States in 1974 declined to 1,003 barrels from the 1973 levels of 401,000 barrels. This decrease reflects a shift in the purchase pattern by Japan to other propane exporting countries.

The breakdown of exports between the various products were as follows: Butane 1.5%, propane 25.9%, and butane-propane mixtures 72.6%.

WORLD REVIEW

The United States and Canada dominated world natural gas plant liquids output. Their combined production accounted for 72% of the total world production. In the Middle East, NGL production from the three major producers of associated gas, Iran, Kuwait, and Saudi Arabia, amounted to 71.8 million barrels or 7% of the total. Of these countries, as indicated in table 20, Saudi Arabia showed the largest increase in production.

In Algeria construction began on a plant to produce 450,000 tons per year of butane and propane, with allowances for future expansion to 750,000 tons per year. This plant is to be constructed by the State-owned petroleum company, Société Nationale pour la Recherche, la Production, le Transport, la Transformation, et la Commercialisation des Hydrocarbures (SONATRACH). Construction began in Argentina on a natural gas processing plant to produce 61,500 tons per year of propane and butane.

The Canadian Government approved two projects, one a major ethylene plant and the other a dual pipeline system, to transport ethane and propane to the United States and throughout Canada. An ethane plant will be built at Fort Saskatchewan by Dow Chemical of Canada Ltd. Dome Petroleum Ltd. will build a twin pipeline system from Fort Saskatchewan to Sarnia, Ontario. One will carry ethylene from Alberta to Sarnia and the other light hydrocarbons, mainly ethane, to a point in Michigan. The hydrocarbons line will then join a new line to Green Springs, Ohio. Initially, Dome will be permitted to export 84 million barrels of ethane between 1976 and 1983 and 17 million barrels of propane between 1978 and 1982. Canada had proved NGL reserves of 1.6 billion barrels at the end of 1974. This represents a 25-million-barrel increase over the 1973 yearend reserve figure and ended 4 consecutive years of decline.

The Government of Dubai entered a joint venture with Sunningdale Oils, Ltd., to construct a gas-processing plant and gathering facilities to extract NGL. In Dubai as in most other Persian Gulf oil-producing States, large volumes of natural gas, being produced in association with the output of petroleum, are currently wasted.

The Hungarian Oil and Gas Trust began construction of a new plant at Szeged, Hungary, for processing natural gas. First stage processing capacity is 3.75 million cubic feet of gas per day.

Atlantic Richfield Co. finalized plans for the construction of a 375,000-barrel-capacity, prestressed concrete LPG storage barge. This barge, the first ever constructed for refrigeration and storage of LPG, is a part of the world's first totally offshore facility for the recovery, storage, and loading of NGL. This facility is currently being built in the Java Sea offshore Indonesia.

In Saudi Arabia the Arabian American Oil Company announced that its production of NGL rose by some 42% during 1974 to an average of about 138,000 barrels per day.

Texas Eastern Transmission Corp. and a Northern Natural Gas Co. subsidiary, UPG Inc., bought 143 acres on the Houston Ship Channel for a major terminal for gas liquids imports. The project would involve a 14-mile pipeline to Texas Eastern's Mont Belvieu, Tex., underground-storage terminal. This action is in anticipation of future increased imports required to close the gap between domestic demand and domestic supply of NGL.

TECHNOLOGY

New cryogenic technology for extracting higher percentages of the ethane from natural gas has been developed. Extraction of ethane in the range of 70% to 80% of total content in the gas was generally uneconomical until the development of this new cryogenic technique. Thus, industry now has the ability to add large new increments of ethane from an essentially static natural gas supply.

The technique employs turbines through which high-pressure gas is expanded, resulting in very low temperatures (about −150°F). Ethane and heavier components of the gas are liquefied at the low temperatures, allowing their separation from the gas.

Table 2.—Plant production, stocks at plants and terminals, shipments from plants of natural gas processing plant products in 1974

(Thousand barrels)

Product	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total 1974	Total 1973
Ethane:														
Production	9,456	9,003	10,784	9,725	9,945	9,441	9,554	9,659	9,168	10,344	10,112	10,600	117,791	108,220
Stocks	4,747	4,451	4,533	4,644	5,185	5,424	5,423	5,319	5,088	4,945	4,560	4,562	4,562	5,023
Shipments	9,732	9,299	10,702	9,614	9,404	9,202	9,555	9,763	9,399	10,487	10,497	10,598	118,252	110,249
Liquefied petroleum gases:														
Production	28,149	26,018	29,201	27,798	28,157	26,723	27,048	27,301	26,331	28,083	27,383	27,968	330,155	338,813
Stocks	75,301	74,280	78,781	84,793	93,191	99,081	106,619	112,730	114,379	112,236	107,203	97,956	97,956	83,086
Shipments	35,934	27,039	24,700	21,786	19,759	20,833	19,505	21,190	24,682	30,226	32,416	37,215	315,285	323,534
Isopentane:														
Production	487	416	460	254	268	263	268	306	248	270	266	293	3,794	5,828
Stocks	26	27	26	13	15	16	18	15	17	17	16	16	16	32
Shipments	493	415	461	267	266	262	261	309	246	270	267	293	3,810	5,895
Natural gasoline:														
Production	12,551	11,270	11,639	11,407	12,449	12,427	12,844	13,031	11,883	11,914	11,455	11,259	144,129	155,880
Stocks	5,037	5,483	5,275	5,605	5,715	6,154	6,156	6,455	6,393	5,876	5,602	5,202	5,202	5,043
Shipments	12,557	10,824	11,847	11,077	12,339	11,988	12,842	12,732	11,945	12,431	11,729	11,659	143,970	154,122
Plant condensate:														
Production	1,644	1,484	1,676	1,475	1,367	1,471	1,466	1,468	1,366	1,469	1,412	1,435	17,733	19,838
Stocks	530	366	632	524	516	573	465	480	465	441	514	507	507	739
Shipments	1,853	1,648	1,410	1,583	1,375	1,414	1,574	1,453	1,381	1,493	1,339	1,442	17,965	19,862
Motor gasoline:														
Production	178	75	84	88	83	82	86	83	63	92	81	89	1,084	3,029
Stocks	79	47	40	53	41	40	51	53	39	49	59	64	64	83
Shipments	182	107	91	75	95	83	75	81	77	82	71	84	1,103	3,070
Special naphthas:														
Production	15	14	16	16	16	15	16	15	14	13	13	12	175	210
Stocks	5	5	4	4	5	5	5	4	4	4	5	4	4	7
Shipments	17	14	17	16	15	15	16	16	14	13	12	13	178	211
Other products:														
Kerosine:														
Production	42	29	30	27	26	12	12	12	12	15	14	14	245	704
Stocks	39	24	26	23	20	15	16	14	16	16	17	17	17	37
Shipments	40	44	28	30	29	17	11	14	10	15	13	14	265	710
Distillate fuel oil:														
Production	54	19	23	20	17	19	18	16	20	17	19	19	261	835
Stocks	38	37	30	34	37	35	37	37	39	37	38	39	39	40
Shipments	56	20	30	16	14	21	16	16	18	19	18	18	262	830
Miscellaneous products:														
Production	96	64	70	62	51	61	52	51	39	51	62	72	731	1,066
Stocks	18	14	15	14	14	13	14	13	14	13	12	10	10	16
Shipments	94	68	69	68	51	62	51	52	38	52	63	74	737	1,072
Other products total:														
Production	192	112	123	109	94	92	82	79	71	83	95	105	1,237	2,605
Stocks	95	75	71	71	71	63	67	64	69	66	67	66	66	93
Shipments	190	132	127	109	94	100	78	82	66	86	94	106	1,264	2,612
All products total:														
Production	52,672	48,392	53,983	50,872	52,379	50,514	51,354	51,942	49,144	52,268	50,817	51,761	616,098	634,423
Stocks	85,820	84,734	89,362	95,707	104,739	111,356	118,804	125,120	126,454	123,634	118,026	108,377	108,377	94,106
Shipments	60,958	49,478	49,355	44,527	43,347	43,897	43,906	45,626	47,810	55,088	56,425	61,410	601,827	619,555

Table 3.—Total production of products of natural gas processing plants, by State and month, 1974

(Thousand barrels)

State	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
Arkansas	60	46	44	56	56	53	50	52	49	51	49	51	617
California	966	890	940	919	930	904	938	918	888	880	838	808	10,804
Colorado	269	250	282	296	311	286	292	301	340	528	510	489	4,154
Florida, Pennsylvania, West Virginia	751	700	801	767	727	686	687	776	524	814	792	785	8,810
Illinois and Kentucky	974	987	1,089	1,141	1,085	1,076	1,088	1,105	1,075	841	1,054	1,118	12,628
Kansas	2,632	2,466	2,585	2,527	2,675	2,291	2,475	2,645	2,495	2,821	2,676	2,744	31,032
Louisiana	13,114	11,389	12,879	11,767	12,088	11,590	11,750	11,974	10,630	12,506	12,059	12,553	144,299
Michigan	77	67	79	69	129	115	149	137	133	135	108	122	1,315
Mississippi and Alabama	54	46	49	50	54	51	68	94	82	80	76	80	784
Montana, Utah, Alaska	290	299	325	330	345	342	362	362	333	365	330	335	4,018
Nebraska, North Dakota, South Dakota	165	159	179	166	166	165	167	176	168	181	174	166	2,032
New Mexico	3,385	3,139	3,491	3,314	3,489	3,192	3,260	3,344	3,376	3,332	3,308	3,354	39,984
Oklahoma	3,750	3,583	3,788	3,675	3,690	3,584	3,692	3,595	3,507	3,683	3,598	3,672	43,812
Texas	25,343	23,594	26,612	24,971	25,820	25,420	25,578	25,667	24,739	25,205	24,446	24,682	302,072
Wyoming	842	777	840	824	814	759	813	801	805	846	814	802	9,737
Total	52,672	48,392	53,983	50,872	52,379	50,514	51,354	51,942	49,144	52,268	50,817	51,761	616,09

Table 4.—Production of natural gas liquids at natural gas processing plants, and disposition of residue gas in the United States in 1973–74, by State

(Million cubic feet at 14.73 psia at 60°F unless otherwise stated)

State	Total natural gas liquids and ethane production (thousand 42 gallons barrels)	Natural gas processed	Extraction loss (shrinkage)	Disposition of residue gas						
				Used at plants	Returned to formation	Vented and flared	Shipped to transmission companies	Direct deliveries to consumers	Unaccounted for	Total
1973:										
Arkansas	653	26,135	1,118	2,513	194	8	20,030	2,618	−346	25,017
California	12,194	276,385	17,498	19,563	131,636	--	71,949	33,420	2,319	258,887
Colorado	3,402	110,662	4,674	3,107	4,145	109	98,747	--	−120	105,988
Florida, Pennsylvania, West Virginia	8,554	375,090	12,385	4,391	11	--	357,722	581	--	362,705
Illinois and Kentucky	12,473	358,142	18,975	2,793	--	--	333,518	2,681	175	339,167
Kansas	30,456	1,503,660	43,909	9,746	1,678	65	1,366,017	82,363	−118	1,459,751
Louisiana	150,607	6,524,729	206,833	108,812	130,323	2,863	5,213,818	866,070	−3,990	6,317,896
Michigan	1,063	37,384	1,581	1,295	1,778	61	32,743		−74	35,803
Mississippi and Alabama	717	29,081	1,077	1,590	3,605	--	20,746	1,991	72	28,004
Montana, Utah, Alaska	3,823	140,416	5,393	6,175	92,070	1,819	29,871	6,906	−1,818	135,023
Nebraska, North Dakota, South Dakota	2,246	33,369	3,443	3,305	6,266	87	19,858	--	410	29,926
New Mexico	39,500	1,101,341	55,782	48,582	4,764	3,178	860,313	122,409	6,313	1,045,559
Oklahoma	43,718	1,175,548	61,647	49,710	77,372	1,078	897,361	84,793	3,587	1,113,901
Texas	314,429	7,683,830	466,143	299,738	823,369	7,671	5,279,049	748,629	59,231	7,217,687
Wyoming	10,588	303,519	16,093	10,386	10,946	576	257,539	8,722	−743	287,426
Total	634,423	19,679,291	916,551	571,706	1,288,157	17,515	14,859,281	1,961,183	64,898	18,762,740
1974:										
Arkansas	617	19,784	952	2,471	137	--	14,323	1,722	179	18,832
California	10,804	252,402	17,201	20,343	129,332	159	58,564	24,118	2,685	235,201
Colorado	4,154	118,686	6,210	4,612	4,949	437	100,748	1,364	366	112,476
Florida, Pennsylvania, West Virginia	8,810	409,248	13,049	4,720	8	--	391,108	363	--	396,199
Illinois and Kentucky	12,628	342,046	19,378	4,319	--	--	316,163	1,984	202	322,668
Kansas	31,032	1,407,239	43,416	10,165	1,742	159	1,301,549	50,149	59	1,363,823
Louisiana	144,299	6,273,136	194,329	103,973	102,858	1,510	5,169,920	704,324	−3,778	6,078,807
Michigan	1,315	45,106	1,921	1,713	1,994	38	39,708	--	−268	43,185
Mississippi and Alabama	784	24,568	1,180	1,638	3,070	67	13,899	4,532	182	23,388
Montana, Utah, Alaska	4,018	146,907	5,912	6,071	92,638	1,416	28,916	9,192	2,762	140,995
Nebraska, North Dakota, South Dakota	2,032	34,243	3,031	3,182	7,267	66	20,454	--	243	31,212
New Mexico	39,984	1,060,491	54,986	49,981	4,489	2,902	846,035	97,612	4,486	1,005,505
Oklahoma	43,812	1,092,487	62,860	51,138	72,012	897	823,053	77,391	5,136	1,029,627
Texas	302,072	7,194,453	448,993	289,419	721,678	9,219	4,962,687	709,383	53,074	6,745,460
Wyoming	9,737	263,684	14,072	9,497	8,997	391	224,561	6,478	−312	249,612
Total	616,098	18,684,480	887,490	563,242	1,151,171	17,261	14,311,688	1,688,612	65,016	17,796,990

Table 5.—Natural gas liquids production and value at natural gas processing plants, by State and product

State	LPG and ethane			Natural gasoline and isopentane			Plant condensate		
	Quantity (thousand barrels)	Value (thousands)	Dollars per barrel[1]	Quantity (thousand barrels)	Value (thousands)	Dollars per barrel[1]	Quantity (thousand barrels)	Value (thousands)	Dollars per barrel[1]
Arkansas	418	$2,491	$5.96	185	$1,258	$6.80	9	$60	$6.64
California	5,095	29,296	5.75	5,260	23,617	4.49	449	2,487	5.54
Colorado	2,580	14,190	5.50	1,572	9,306	5.92	2	13	6.55
Florida, Pennsylvania, West Virginia	7,614	29,686	3.90	1,193	5,744	4.81	--	--	--
Illinois and Kentucky	12,155	50,524	4.16	464	2,164	4.66	9	31	3.49
Kansas	24,402	78,818	3.23	6,622	24,766	3.74	7	41	5.88
Louisiana	108,439	423,996	3.91	31,012	207,160	6.68	3,942	22,193	5.63
Michigan	849	5,383	6.34	462	3,068	6.64	--	--	--
Mississippi and Alabama	489	3,020	6.18	285	1,650	5.79	--	--	--
Montana, Utah, Alaska	2,298	11,507	5.01	1,715	8,994	5.24	5	29	5.80
Nebraska, North Dakota, South Dakota	1,545	8,256	5.34	487	2,575	5.29	--	--	--
New Mexico	30,271	120,781	3.99	9,521	52,366	5.50	138	916	6.64
Oklahoma	31,231	166,461	5.33	11,814	78,918	6.68	668	5,217	7.81
Texas	213,756	1,004,653	4.70	74,667	536,109	7.18	12,235	83,198	6.80
Wyoming	6,804	31,707	4.66	2,664	17,130	6.43	269	1,447	5.38
Total	447,946	1,980,769	4.42	147,923	974,825	6.59	17,733	115,632	6.52

State	Finished gasoline and naphtha			Other products[2]			Total		
	Quantity (thousand barrels)	Value (thousands)	Dollars per barrel[1]	Quantity (thousand barrels)	Value (thousands)	Dollars per barrel[1]	Quantity (thousand barrels)	Value (thousands)	Dollars per barrel[1]
Arkansas	--	--	--	5	26	5.17	617	3,835	6.22
California	--	--	--	--	--	--	10,804	55,400	5.13
Colorado	--	--	--	--	--	--	4,154	23,509	5.66
Florida, Pennsylvania, West Virginia	--	--	--	3	10	3.32	8,810	35,440	4.02
Illinois and Kentucky	--	--	--	--	--	--	12,628	52,719	4.17
Kansas	--	--	--	1	3	2.90	31,032	103,628	3.34
Louisiana	392	2,815	7.18	514	2,786	5.42	144,299	658,950	4.57
Michigan	--	--	--	4	21	5.21	1,315	8,472	6.44
Mississippi and Alabama	--	--	--	10	52	5.17	784	4,722	6.02
Montana, Utah, Alaska	--	--	--	--	--	--	4,018	20,530	5.11
Nebraska, North Dakota, South Dakota	--	--	--	--	--	--	2,032	10,831	5.33
New Mexico	--	--	--	54	263	4.87	39,984	174,326	4.36
Oklahoma	--	--	--	99	503	5.08	43,812	251,099	5.73
Texas	867	7,213	8.32	547	3,009	5.50	302,072	1,634,182	5.41
Wyoming	--	--	--	--	--	--	9,737	50,284	5.16
Total	1,259	10,028	7.97	1,237	6,673	5.39	616,098	3,087,927	5.01

[1] Represents average unit value of sales throughout the year.
[2] Includes kerosine, distillate fuel oil, and miscellaneous products.

Source: Company reports and Bureau of Mines estimates.

Table 6.—Production of natural gas liquids and ethane at natural gas processing plants in the United States in 1974

(Thousand barrels)

PAD districts and States	Ethane	Liquefied petroleum gases						Natural gasoline and isopentane	Plant condensate	Finished gasoline and naphtha	All other products [1]	Total
		Propane	Normal butane	Other butanes	Butane-propane mixture	Iso-butane	Total					
District I	([2])	3,999	857	793	--	([2])	[2]5,649	([2])	--	--	3	[2]5,652
District II:												
Michigan	--	471	128	--	110	140	849	462	--	--	4	1,315
Kansas	3,635	14,174	4,459	527	1	1,606	20,767	6,622	7	--	1	31,032
Nebraska and North Dakota	--	914	566	39	--	--	1,519	484	--	--	--	2,003
Oklahoma	3,819	18,381	5,112	2,300	28	1,591	27,412	11,814	668	--	99	43,812
Other states [3]	[2]8,921	3,732	795	--	--	[2]698	[2]5,225	[2]1,660	9	--	--	[2]5,815
Total District II	[2]16,375	37,672	11,060	2,866	139	[2]4,035	[2]55,722	[2]21,042	684	--	104	[2]93,977
District III:												
Alabama and Mississippi	--	192	135	70	92	--	489	285	--	--	10	784
Arkansas	--	225	104	22	--	67	418	185	9	--	5	617
Louisiana:												
Gulf	36,348	41,590	13,019	523	34	12,233	67,399	29,832	3,374	94	442	137,489
Inland	1,033	2,102	775	86	107	589	3,659	1,180	568	298	72	6,810
Total Louisiana	37,381	43,692	13,794	609	141	12,822	71,058	31,012	3,942	392	514	144,299
New Mexico	4,622	14,836	4,824	4,079	13	1,897	25,649	9,521	138	--	54	39,984
Texas:												
Gulf	16,491	15,880	5,351	459	617	3,878	26,180	11,778	1,737	212	112	56,510
West	21,959	40,963	11,490	5,572	188	3,115	61,328	26,229	2,561	--	7	112,084
East (field)	828	3,051	2,023	--	349	362	5,785	1,886	33	--	23	8,555
Panhandle	1,007	13,440	2,725	7,223	--	1,676	25,064	12,162	33	--	78	38,344
Other	18,886	21,340	7,180	1,746	1,166	4,796	36,228	22,612	7,871	655	327	86,579
Total Texas	59,171	94,674	28,769	15,000	2,320	13,822	154,585	74,667	12,235	867	547	302,072
Total District III	101,174	153,619	47,626	19,780	2,566	28,608	252,199	115,670	16,324	1,259	1,180	487,756
District IV:												
Colorado	212	1,532	38	791	--	7	2,368	1,572	2	--	--	4,154
Montana and Utah	--	1,466	687	52	--	93	2,298	1,018	5	--	--	3,321
Wyoming	30	4,442	1,415	735	--	182	6,774	2,664	269	--	--	9,737
Total District IV	242	7,440	2,140	1,578	--	282	11,440	5,254	276	--	--	17,212
District V	--	3,809	328	148	322	493	5,095	5,957	449	--	--	11,501
Total United States	117,791	206,539	62,006	25,165	3,027	33,418	330,155	147,923	17,738	1,259	1,237	616,098

[1] Includes jet fuel, kerosine, distillate, and other.
[2] District I ethane, butane and natural gasoline and isopentane data included with District II, Other States.
[3] Other States includes Florida, Illinois, Kentucky, Pennsylvania, South Dakota and West Virginia for ethane and natural gasoline and isopentane only.

Table 7.—Production of natural gasoline by vapor pressure and PAD district in the United States, in 1974

(Thousand barrels)

Reid vapor pressure	District I	District II	District III	District IV	District V	Total
12 pounds and less	331	2,815	68,896	1,242	767	74,051
Over 12 pounds including 14 pounds	847	6,746	20,872	1,926	45	30,436
Over 14 pounds including 18 pounds	3	4,400	7,124	433	147	12,107
Over 18 pounds including 22 pounds	12	262	847	49	1,040	2,210
Over 22 pounds including 26 pounds	--	1,449	6,926	236	656	9,267
Over 26 pounds	--	3,502	7,999	1,255	3,302	16,058
Total	1,193	19,174	112,664	5,141	5,957	144,129

Table 8.—Comparison of 1973 and 1974 natural gas liquids production and value

	Thousand barrels		Percent change	Thousand dollars		Percent change	Dollars per barrel		Percent change
	1973	1974		1973	1974		1973	1974	
LPG and ethane	447,033	447,946	+0.2	1,188,289	1,980,769	+66.7	2.66	4.42	+66.2
Natural gasoline and isopentane	161,708	147,923	−8.5	568,214	974,825	+71.6	3.51	6.59	+87.7
Plant condensate	19,838	17,733	−10.6	78,189	115,632	+47.9	3.94	6.52	+65.5
Finished gasoline and naphtha	3,239	1,259	−61.1	13,902	10,028	−27.9	4.29	7.97	+85.8
Other products	2,605	1,237	−52.5	8,479	6,673	−21.3	3.25	5.39	+65.8
Total or average	634,423	616,098	−2.9	1,857,073	3,087,927	+66.3	2.93	5.01	+71.0

Table 9.—Estimated proved recoverable reserves of natural gas liquids in the United States

(Thousand barrels)

State	Reserves Dec. 31, 1973	Changes in reserves in 1974		Reserves Dec. 31, 1974		Total
		Extensions and revisions	New field and new reservoir discoveries	Non-associated	Associated—dissolved	
Alabama	44,592	76,682	--	116,998	1,625	118,623
Alaska	343	600	--	--	845	845
Arkansas	5,044	580	--	3,124	1,624	4,748
California [1]	105,963	2,996	--	3,004	95,228	98,232
Colorado	20,853	3,297	24	10,867	9,822	20,689
Florida	3,307	−3,307	--	--	--	--
Kansas	387,298	37,317	522	386,892	7,527	394,419
Kentucky	45,324	2,247	397	44,676	--	44,676
Louisiana [1]	1,992,537	89,625	33,701	1,607,399	274,982	1,882,381
Michigan	25,046	−6,014	2,599	4,906	15,358	20,264
Mississippi	14,090	−1,282	1,147	7,021	5,572	12,593
Montana	3,625	--	--	459	2,487	2,946
Nebraska	1,292	76	--	384	671	1,055
New Mexico	413,180	22,056	166	288,303	108,726	397,029
North Dakota	53,345	240	100	79	51,777	51,856
Oklahoma	289,102	41,697	1,306	191,087	99,240	290,327
Pennsylvania	659	--	--	580	--	580
Texas [1]	2,830,143	266,203	33,665	1,320,969	1,476,019	2,796,988
Utah	52,544	3,164	--	645	51,709	52,354
West Virginia	82,755	1,817	2,725	81,755	--	81,755
Wyoming	83,665	5,486	9	39,980	38,109	78,089
Total	6,454,707	543,480	76,361	4,109,128	2,241,321	6,350,449

[1] Includes offshore.

Source: American Gas Association.

Table 10.—Estimated productive capacity of natural gas liquids in the United States[1]

(Thousand barrels per day)

State	Productive capacity		
	Non-associated	Associated—dissolved	Total
Alabama	17	1	18
Arkansas	1	1	2
California[2]	--	36	36
Colorado	5	7	12
Florida	--	116	116
Kansas	124	6	130
Kentucky	9	--	9
Louisiana[2]	613	78	691
Michigan	4	5	9
Mississippi	2	3	5
Montana	1	1	2
Nebraska	1	1	2
New Mexico	62	46	108
North Dakota	--	5	5
Oklahoma	117	66	183
Texas[2]	551	475	1,026
Utah	1	9	10
West Virginia	15	--	15
Wyoming	13	17	30
Total	1,536	873	2,409

[1] During the heating season immediately following Dec. 31, 1974.
[2] Includes offshore.

Source: American Gas Association.

Table 11.—Production, stocks, and demand of liquefied gases and ethane at gas-processing plants and refineries

(Thousand barrels)

	Ethane	Propane	Butane	Butane-propane mixtures	Isobutane	Total
Production:						
At gas-processing plants	117,791	206,539	87,171	3,027	33,418	447,946
At refineries:						
For fuel use	--	62,298	13,598	5,665	--	81,561
For chemical use	6,330	25,155	6,442	655	3,181	41,763
Total	124,121	293,992	107,211	9,347	36,599	571,270
Net change in stocks:						
Liquefied petroleum gases:						
At gas-processing plants	−461	5,009	5,703	739	3,419	14,409
At refineries	--	−260	843	−102	799	1,280
Liquefied refinery gases:						
For fuel use	--	−715	−457	−474	--	−1,646
For chemical use	--	−75	23	−2	−88	−142
Exports	--	4,971	4,067	--	--	9,038
Imports	--	21,464	23,248	--	--	44,712
Used at refineries	--	3,465	45,612	1,953	29,187	80,217
Domestic demand:						
At gas-processing plants	118,252	214,818	54,194	437	--	387,701
At refineries:						
For fuel use	--	63,013	14,055	6,139	--	83,207
For chemical use	6,330	25,230	6,419	657	3,282	41,918
Total	124,582	303,061	74,668	7,233	3,282	512,826
Yearend stocks:						
Liquefied petroleum gases:						
At gas-processing plants	4,562	64,713	20,992	1,565	10,686	102,518
At refineries	--	97	2,212	26	1,758	4,093
Liquefied refinery gases:						
For fuel use	--	3,684	2,014	59	--	5,757
For chemical use	--	112	39	1	22	174
Total	4,562	68,606	25,257	1,651	12,466	112,542

Table 12.—Natural gas liquids[1] used as refinery input in the United States in 1974, by Bureau of Mines refinery district, and by month

(Thousand barrels)

District	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
East coast	27	131	173	220	73	85	60	28	164	145	108	122	1,336
Appalachian	337	172	432	261	101	206	261	324	414	391	355	313	3,567
Indiana, Illinois, Kentucky, etc	2,844	2,440	2,453	2,296	2,319	2,287	2,313	2,878	2,601	3,221	2,930	3,279	31,811
Minnesota, Wisconsin, North Dakota, South Dakota	1,096	988	1,095	772	595	972	939	854	975	743	680	791	10,500
Oklahoma, Kansas, Missouri	2,062	1,893	1,897	1,846	1,916	1,888	2,019	2,017	1,940	2,353	2,316	2,455	24,602
Texas:													
Inland	1,780	1,797	1,812	1,706	1,839	1,855	1,916	1,846	1,665	2,053	2,002	1,789	22,060
Gulf coast	9,553	8,031	7,886	7,576	8,402	8,311	8,852	9,058	8,346	8,831	8,560	9,040	102,446
Total	11,333	9,828	9,698	9,282	10,241	10,166	10,768	10,904	10,011	10,884	10,562	10,829	124,506
Louisiana-Arkansas:													
Louisiana gulf coast	3,383	2,821	2,939	2,892	3,244	2,964	2,965	3,071	2,919	3,475	3,334	3,275	37,282
Arkansas and Louisiana inland	459	435	428	392	378	386	528	469	455	532	591	612	5,665
Total	3,842	3,256	3,367	3,284	3,622	3,350	3,493	3,540	3,374	4,007	3,925	3,887	42,947
New Mexico	167	115	123	106	133	133	148	116	125	140	148	132	1,586
Other Rocky Mountain	1,396	1,482	1,361	1,254	761	1,230	1,062	1,097	1,367	1,127	1,264	1,322	14,723
West coast	1,504	1,445	1,721	1,391	1,270	1,258	1,346	1,231	1,178	1,407	1,555	1,532	16,838
Total United States	24,608	21,750	22,320	20,712	21,031	21,525	22,409	22,989	22,149	24,418	23,848	24,662	272,416

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[1] Comprises plant condensate (including imports), natural gasoline, LPG, and isopentane.

Table 13.—Liquefied refinery gases and ethane produced at refineries for fuel and chemical use in 1974

(Thousand barrels)

States and PAD districts	Ethane	Propane	Butane	Butane-propane mixture	Total
District I:					
New Jersey	17	4,996	1,125	--	6,138
Pennsylvania	--	6,459	680	108	7,247
Other States [1]	--	3,362	282	--	3,644
Total District I	17	14,817	2,087	108	17,029
District II:					
Illinois	--	10,110	441	--	10,551
Indiana	--	563	258	1	822
Kansas	442	3,378	95	1	3,916
Kentucky	--	558	--	--	558
Michigan	--	1,253	126	--	1,379
Ohio	76	5,119	137	--	5,332
Oklahoma	--	2,553	279	80	2,912
Other States [2]	--	1,853	142	84	2,079
Total District II	518	25,387	1,478	166	27,549
District III:					
Alabama and Mississippi	--	1,771	936	300	3,007
Arkansas	--	371	42	--	413
Louisiana:					
Gulf	1,375	8,731	1,324	2,362	13,792
Inland	--	126	346	151	623
Total Louisiana	1,375	8,857	1,670	2,513	14,415
New Mexico	--	151	165	77	393
Texas:					
Gulf	3,813	22,264	11,261	408	37,746
Inland	96	2,534	664	321	3,615
Total Texas	3,909	24,798	11,925	729	41,361
Total District III	5,284	35,948	14,738	3,619	59,589
District IV:					
Colorado	--	111	62	2	175
Montana	--	624	66	38	728
Utah	--	401	31	4	436
Wyoming	--	254	175	100	529
Total District IV	--	1,390	334	144	1,868
District V:	511	9,911	4,584	2,283	17,289
Total United States	6,330	87,453	[3] 23,221	6,320	123,324

[1] Includes Delaware, New York, Virginia, and West Virginia.
[2] Includes Minnesota, Missouri, Nebraska, North Dakota, Tennessee, and Wisconsin.
[3] Includes 3,181,000 barrels of isobutane used for petrochemical feedstock.

Table 14.—Refinery input and stocks of natural gas plant products and refinery output and stocks of liquefied refinery gases, by product

(Thousand barrels)

	PAD Districts																
	I			II					III						IV	V	
	East Coast	Appalachian #1	Total	Appalachian #2	Indiana, Illinois, etc.	Minnesota, Wisconsin, etc.	Oklahoma, Kansas, etc.	Total	Texas Inland	Texas Gulf	Louisiana Gulf	Arkansas, Louisiana Inland etc.	New Mexico	Total	Other Rocky Mt.	West Coast	United States
Natural gas plant products:																	
Refinery inputs:																	
Propane	--	--	--	--	--	--	--	--	7	492	2,943	--	--	3,442	10	13	3,465
Isobutane	--	36	36	569	4,849	877	5,390	11,685	4,303	4,771	5,913	697	243	15,927	865	2,316	30,829
Normal butane	214	19	233	144	7,152	748	4,093	12,137	1,211	4,445	7,677	70	170	13,573	361	2,806	29,110
Other butane	--	73	73	--	4,169	781	2,326	7,276	298	1,602	967	198	24	3,089	1,928	1,489	13,855
Butane-propane mix	34	--	34	--	60	--	1	61	--	1,086	691	--	155	1,932	443	488	2,958
Natural gasoline	263	--	263	--	5,238	4,546	30	15,140	512	80,872	17,766	1,272	994	116,633	1,945	7,214	147,603
Plant condensate	825	2,505	3,330	221	10,343	3,548	12,762	21,548	15,729	9,178	1,325	3,428	--	14,443	9,171	2,512	44,596
Total	1,336	2,633	3,969	934	31,811	10,500	24,602	67,847	22,060	102,446	37,282	5,665	1,586	169,039	14,723	16,838	272,416
Stocks at refineries:[1]																	
Propane	--	--	--	--	--	--	--	--	--	--	35	--	--	35	62	--	97
Isobutane	--	--	--	10	78	26	265	379	19	428	866	7	2	1,322	17	40	1,758
Normal butane	--	--	--	48	21	53	412	534	1	1,338	217	--	--	1,556	11	--	2,101
Other butane	--	--	--	--	--	20	20	40	6	9	--	1	--	16	54	1	111
Butane-propane mix	--	--	--	--	--	--	--	--	--	--	6	--	9	15	11	--	26
Natural gasoline	--	--	--	--	101	85	85	271	316	462	84	63	3	928	23	40	1,262
Plant condensate	131	--	131	--	78	35	--	113	--	101	--	79	--	180	123	16	563
Total	131	--	131	58	278	219	782	1,337	342	2,338	1,208	150	14	4,052	301	97	5,918
Liquefied refinery gases:																	
Refinery outputs:																	
Propane and/or propylene	13,808	1,009	14,817	448	17,321	1,319	6,299	25,387	2,534	22,264	10,213	786	151	35,948	1,390	9,911	87,453
Butane and/or butylene	2,086	1	2,087	--	852	111	374	1,337	587	9,425	2,260	388	165	12,825	325	3,466	20,040
Butane-propane mix	108	--	108	--	1	84	81	166	321	408	2,585	228	77	3,619	144	2,283	6,320
Isobutane	--	--	--	--	110	--	31	141	77	1,836	--	--	--	1,913	9	1,118	3,181
Total	16,002	1,010	17,012	448	18,284	1,514	6,785	27,081	3,519	33,933	15,058	1,402	393	54,305	1,868	16,778	116,994
Stocks at refineries:[1]																	
Propane and/or propylene	473	12	485	2	662	30	344	1,038	117	829	825	8	2	1,781	81	411	3,796
Butane and/or butylene	259	--	259	--	183	4	75	262	84	43	624	12	6	769	94	669	2,053
Butane-propane mix	--	--	--	--	--	--	1	1	1	3	2	3	--	9	16	34	60
Isobutane	--	--	--	--	--	--	10	10	--	11	--	--	--	11	1	--	22
Total	732	12	744	2	845	34	430	1,311	202	886	1,451	23	8	2,570	192	1,114	5,981

[1] Stocks as of December 31, 1974.

Table 15.—Refinery input of LPG, by product and PAD district

(Thousand barrels)

Item	PAD districts I	II	III	IV	V	United States
1972						
Propane	--	5	3,851	--	78	3,934
Normal butane	215	9,287	18,171	782	3,345	31,800
Other butanes	53	6,513	2,340	1,238	1,220	11,364
Isobutane	73	10,127	21,817	878	1,734	34,629
Butane-propane mix	--	340	1,880	374	872	3,466
Total LPG	341	26,272	48,059	3,272	7,249	85,193
1973						
Propane	--	435	2,278	7	35	2,755
Normal butane	148	7,419	14,864	385	3,174	25,990
Other butanes	89	6,345	1,839	1,804	1,190	11,267
Isobutane	38	12,171	20,877	965	1,672	35,723
Butane-propane mix	--	335	2,720	282	1,149	4,486
Total LPG	275	26,705	42,578	3,443	7,220	80,221
1974						
Propane	--	--	3,442	10	13	3,465
Normal butane	233	12,137	13,573	361	2,806	29,110
Other butanes	73	7,276	3,089	1,928	1,489	13,855
Isobutane	36	11,685	15,927	865	2,316	30,829
Butane-propane mix	34	61	1,932	443	488	2,958
Total LPG	376	31,159	37,963	3,607	7,112	80,217

Table 16.—Stocks of natural gas liquids and ethane in the United States

(Thousand barrels)

Date	LP gases and ethane: At plants and terminals	LP gases and ethane: At refineries	Natural gasoline and isopentane: At plants and terminals	Natural gasoline and isopentane: At refineries	Other finished products and plant condensate: At plants and terminals	Other finished products and plant condensate: At refineries	Total at plants and terminals	Total at refineries	Grand total
Dec. 31:									
1970	60,595	794	4,323	1,765	1,074	451	65,992	3,010	69,002
1971	83,659	3,693	3,678	1,485	1,084	419	88,421	5,597	94,018
1972	74,859	3,077	3,384	1,418	995	510	79,238	5,005	84,243
1973	88,109	2,813	5,075	1,085	922	936	94,106	4,834	98,940
1974:									
Jan. 31	80,048	2,947	5,063	1,365	709	1,078	85,820	5,390	91,210
Feb. 28	78,731	3,137	5,510	1,195	493	1,079	84,734	5,411	90,145
Mar. 31	83,314	3,076	5,301	1,241	747	1,138	89,362	5,455	94,817
Apr. 30	89,437	3,361	5,618	1,478	652	806	95,707	5,645	101,352
May 31	98,376	3,846	5,730	1,715	633	581	104,739	6,142	110,881
June 30	104,505	4,178	6,170	1,738	681	643	111,356	6,559	117,915
July 31	112,042	4,429	6,174	1,610	588	584	118,804	6,623	125,427
Aug. 31	118,049	4,555	6,470	1,418	601	582	125,120	6,555	131,675
Sept. 30	119,467	4,561	6,410	1,545	577	655	126,454	6,761	133,215
Oct. 31	117,181	4,858	5,893	1,339	560	726	123,634	6,923	130,557
Nov. 30	111,763	4,450	5,618	1,242	645	729	118,026	6,421	124,447
Dec. 31	102,518	4,098	5,218	1,262	641	563	108,377	5,918	[1] 114,295

[1] Includes 86,411,000 barrels in underground storage.

Table 17.—Average monthly prices, liquefied petroleum gas (propane) in the United States

(Cents per gallon)

	Jan.	Feb.	Mar.	Apr.	May	June	July
New York:[1]							
1973	9.18	9.18	9.18	9.36	9.48	10.42	10.89
1974	17.75	20.81	18.24	18.24	18.24	19.57	20.89
Oklahoma:[1]							
1973	5.67	5.90	6.46	6.93	8.30	9.28	9.50
1974	16.36	16.34	13.71	13.59	13.59	16.55	18.54
Mt. Belvieu, Tex.:[2]							
1973	6.02	6.21	6.74	7.22	8.39	9.44	9.88
1974	16.67	16.31	14.48	14.48	14.48	16.49	18.59
Baton Rouge, La.:[1]							
1973	6.21	6.40	6.91	7.26	8.49	9.16	9.25
1974	16.57	16.12	13.50	13.48	13.48	16.67	19.28
Wood River, Ill.:							
1973	6.96	6.96	7.15	8.09	8.71	8.79	8.79
1974	18.23	17.84	16.34	16.34	16.34	16.34	17.31
Los Angeles, Calif.:							
1973	6.72	6.72	6.86	6.92	6.92	7.78	7.78
1974	13.33	13.98	15.95	15.95	15.95	17.08	17.95

	Aug.	Sept.	Oct.	Nov.	Dec.	Average for year
New York:[1]						
1973	10.89	12.14	11.69	12.37	13.38	10.68
1974	20.35	15.74	15.80	17.74	17.74	18.43
Oklahoma:[1]						
1973	9.50	11.40	13.83	13.83	13.86	9.58
1974	16.94	13.29	13.00	13.00	13.50	14.87
Mt. Belvieu; Tex.:[2]						
1973	9.88	10.78	12.79	12.97	14.42	9.56
1974	17.25	16.33	16.00	15.85	15.85	16.06
Baton Rouge, La.:[1]						
1973	9.25	10.07	11.50	11.85	13.28	9.13
1974	19.02	15.64	15.67	16.64	16.64	16.06
Wood River, Ill.:						
1973	8.79	11.08	13.56	15.08	16.81	10.06
1974	17.34	17.34	17.34	17.34	17.34	17.12
Los Angeles, Calif.:						
1973	7.78	7.78	9.50	10.33	12.74	8.15
1974	17.95	17.95	17.95	17.95	17.95	16.66

[1] Producers' net contract price after discounts and summer-fill allowances in tank cars and transport trucks.

[2] For pipeline input, minimum 10,000 barrels.

Source: Platt's Oil Price Handbook and Oilmanac.

Table 18.—LPG[1] and plant condensate imported into the United States, by country

(Thousand barrels)

	1972	1973	1974
LPG:			
Algeria	--	55	--
Australia	--	38	--
Belgium	--	97	--
Canada	27,853	31,653	30,384
Chad	--	1	--
Chile	126	138	--
France	--	225	--
Hawaii Trade Zone	--	--	6
Indonesia	--	5	32
Iran	--	118	13
Kuwait	5	2	--
Liberia	--	54	--
Libya	120	594	--
Malaysia	68	131	24
Netherlands	--	237	276
Netherland Antilles	--	235	575
Nigeria	--	--	55
Norway	--	103	--
Oman	25	32	16
Saudi Arabia	210	595	1,577
Singapore	--	1	35
United Arab Emirates	--	9	--
United Kingdom	1	856	84
Venezuela	3,993	12,622	11,634
Yemen	--	--	1
Total	32,401	47,801	44,712
Imports by PAD district:			
District I	5,336	8,549	5,958
District II	14,441	18,417	19,304
District III	787	9,116	9,307
District IV	5,405	5,496	5,535
District V	6,432	6,223	4,608
Plant condensate:			
Canada	31,282	37,460	31,840
Venezuela	146	15	524
Total	31,428	37,475	32,364
Total LPG and plant condensate	63,829	85,276	77,076

[1] Includes LRG.

Table 19.—LPG [1] exported from the United States, by country

(Barrels)

Country	1973 Butane	1973 Propane	1973 Butane propane mixtures	1973 Total	1974 Butane	1974 Propane	1974 Butane propane mixtures	1974 Total
Australia	187	101	476	764	--	274	214	488
Bahamas	388	960	--	1,848	19	661	--	680
Bahrain	--	--	550	550	--	--	2,374	2,374
Belgium	720	--	--	720	--	537	--	537
Bermuda	--	--	650	650	257	--	417	674
Brazil	--	--	67	67	1	--	2,778	2,779
Canada	210,481	36,079	116,130	362,640	16,033	31,810	51,404	99,247
Denmark	108	--	248	356	431	--	46	477
French Pacific Islands	--	--	--	--	--	78	712	790
Germany, West	26	213	901	1,140	666	33	150	849
Guatemala	--	728	9,193	9,921	--	15,564	9,074	24,638
Israel	46	2,520	--	2,566	--	194	--	194
Italy	247	1,756	133	2,136	173	579	271	1,023
Jamaica	50	184	33	267	--	615	35	650
Japan	68	401,032	--	401,100	--	1,003	394	1,397
Mexico	537,490	2,738,301	5,852,018	9,127,809	112,925	2,291,557	6,481,674	8,886,156
Netherlands	--	--	38	38		215	1,351	1,566
New Zealand	--	1,351	121	1,472	190	--	--	190
Spain	--	250	1,075	1,325	375	--	--	375
Switzerland	30	194	321	545	113	275	--	388
United Kingdom	192	33	1,522	1,747	573	1,288	32	1,893
Venezuela	--	--	38	38	217	181	1,123	1,521
Other	689	5,050	3,810	9,549	90	744	2,564	3,398
Total	750,672	3,188,752	5,987,324	9,926,748	132,063	2,345,608	6,554,613	9,032,284
Total value (thousands)	$3,855	$23,345	$29,991	$57,191	$1,328	$23,388	$69,748	$92,664

[1] Data includes LRG.

Table 20.—Natural gas plant liquids:

(Thousand 42-gallon

Country [1]	1972					
	Propane	Butane	Subtotal	Natural gasoline and other	Total	Propane
North America:						
Canada	[r] 29,541	[r] 19,459	[r] 49,000	[r] 60,829	[r] 109,829	33,434
Mexico	NA	NA	21,065	2,579	23,644	NA
Trinidad and Tobago	NA	NA	NA	137	137	--
United States	218,039	92,459	310,498	327,718	638,216	212,886
South America:						
Argentina	3,171	4,094	7,265	103	7,368	NA
Bolivia	NA	NA	51	[e] 100	[e] 151	[e] 24
Brazil	--	--	--	1,497	1,497	--
Chile	1,664	1,161	2,825	2,159	4,984	1,811
Colombia	1,220	726	1,946	1,016	2,962	1,271
Ecuador	NA	NA	50	119	169	NA
Peru	308	2	310	447	757	296
Venezuela	NA	NA	20,819	10,116	30,935	NA
Europe:						
France	1,729	1,893	3,622	3,112	6,734	1,739
Germany, West	NA	NA	23	114	[r] 137	NA
Italy	--	--	--	[r] 547	[r] 547	--
Netherlands	--	--	--	380	380	--
Poland	NA	NA	46	257	303	NA
U.S.S.R.[e] [2]	NA	NA	NA	NA	67,000	NA
United Kingdom	NA	NA	NA	[r] 2,375	[r] 2,375	NA
Yugoslavia	NA	NA	[r] [e] 470	[r] 265	[r] [e] 735	NA
Africa:						
Algeria [2]	NA	NA	NA	[r] 7,068	[r] 7,068	NA
Libya	537	2,328	2,865	7,417	10,282	[r] [e] 520
Asia:						
Brunei	133	46	179	579	758	146
Indonesia	NA	NA	[e] 10	[e] 30	[e] 40	NA
Iran	[r] 4,381	3,639	[r] 8,020	3,983	[r] 12,003	5,256
Japan	NA	NA	137	31	168	NA
Kuwait	7,629	7,376	15,005	5,580	20,585	[r] [e] 8,500
Pakistan	NA	NA	NA	NA	65	NA
Saudi Arabia	NA	NA	15,784	4,007	19,791	NA
Taiwan	329	303	632	163	795	428
Oceania:						
Australia	NA	NA	13,920	NA	13,920	NA
New Zealand	NA	NA	[e] 10	NA	[e] 10	5
Total	[3] [r] 268,681	[3] [r] 133,486	[3] [r] 474,552	[3] [r] 442,728	[r] 984,345	[3] 266,316

World production by country

barrels)

1973				1974 [p]				
Butane	Subtotal	Natural gasoline and other	Total	Propane	Butane	Subtotal	Natural gasoline and other	Total
22,436	55,870	62,062	117,932	33,105	22,135	55,240	59,228	114,468
NA	22,274	4,299	26,573	NA	NA	23,484	4,932	28,416
--	--	79	79	--	--	--	--	--
92,275	305,161	329,262	634,423	206,539	90,198	296,737	319,361	616,098
NA	NA	NA	[r] [e] 8,500	NA	NA	NA	NA	[e] 9,000
[e] 24	[e] 48	[e] 100	[e] 148	NA	NA	65	78	143
--	--	1,421	1,421	--	--	--	1,699	1,699
1,161	2,972	2,075	5,047	1,834	1,203	3,037	1,962	4,999
733	2,004	928	2,932	1,268	718	1,986	1,338	3,324
NA	[e] 50	[e] 120	[e] 170	NA	NA	63	109	172
3	299	449	748	210	5	215	453	668
NA	23,382	10,487	33,869	NA	NA	21,521	9,075	30,596
1,750	3,489	3,363	6,852	1,751	1,814	3,565	3,800	7,365
NA	23	114	137	NA	NA	[e] 25	[e] 120	[e] 145
--	--	539	539	--	--	--	615	615
--	--	608	608	--	--	--	[e] 650	[e] 650
NA	46	[e] 260	[e] 306	NA	NA	NA	NA	[e] 300
NA	NA	NA	79,000	NA	NA	NA	NA	83,000
NA	NA	2,698	2,698	NA	NA	NA	3,059	3,059
NA	524	228	752	NA	NA	577	129	706
NA	NA	[r] [e] 10,300	[r] [e] 10,300	NA	NA	NA	NA	[e] 10,500
[r] [e] 2,240	[r] [e] 2,760	[r] [e] 9,900	[r] [e] 12,660	335	1,888	2,223	4,119	6,342
34	180	1,673	1,858	155	31	186	2,514	2,700
NA	10	33	43	NA	NA	NA	NA	[e] 50
5,000	10,256	5,132	15,388	NA	NA	NA	NA	[e] 16,000
NA	151	44	195	NA	NA	172	41	213
[r] [e] 7,800	[r] [e] 16,300	[r] [e] 5,900	[r] [e] 22,200	NA	NA	NA	NA	[e] 17,800
NA	NA	NA	[e] 70	NA	NA	NA	30	30
NA	25,628	9,822	35,450	NA	NA	NA	NA	[e] 38,000
304	732	201	933	381	258	639	194	833
NA	[r] [e] 14,000	[e] 3,200	[r] [e] 17,200	NA	NA	[e] 14,000	[e] 3,300	[e] 17,300
4	9	NA	9	13	12	25	NA	25
[3] 133,764	[3] 486,168	[3] 465,297	1,034,035	[3] 245,591	[3] 118,262	[3] 423,760	[3] 416,806	1,015,216

[e] Estimate. [p] Preliminary. [r] Revised. NA Not available.

[1] In addition to the countries listed, others, including most notably Hungary, the People's Republic of China, and Romania, may also produce natural gas plant liquids, but information is inadequate to make reliable estimates of output levels. Every effort has been made to include in this table only those natural gas liquids produced by natural gas processing plants, and to exclude natural gas liquids obtained from field treatment facilities including wellhead separators, because the latter are normally blended with crude oil and thus are included in statistics on crude oil output. In some cases, however, sources do not clearly specify whether data presented represent only output of natural gas processing plants, or if they include field output. Thus, some of the country figures in this table may include field condensate. Where this appears to be the case, the country has been so footnoted, but it may also be true of other countries.

[3] Total of listed figures only, and as such represents an incomplete total, due to the fact that in the case of some countries, only the total butane and propane or only the total of natural gas liquids is reported in sources, and available information is inadequate to estimate the distribution of these totals by individual type. Summation of totals of propane and butane thus does not equal the reported subtotal, nor does the summation of this subtotal and natural gasoline and other equal the reported natural gas plant liquid total.

Nickel

By John D. Corrick [1]

Domestic nickel consumption in 1974 exceeded the high level reached in 1973 and resulted in a tight supply situation that lasted through most of 1974. The limited availability of nickel resulted from record consumption and a substantial increase in consumer stocks. The supply situation was compounded by delays, up to 6 months, in the scheduled startup of Marinduque Mining & Industrial Corp.'s mine and smelter in the Philippines, Freeport Queensland Nickel Inc.'s mine and treatment plant in Australia, Amax Nickel Divisions' rehabilitated refinery in Louisiana, and production from the mine and smelter located in Botswana. Data collected by the Bureau of Mines indicated that the level of activity in the domestic nickel industry in 1974 was little changed from that in 1973. Domestic nickel consumption in 1974 exceeded the record consumption reported in 1973 by 5% and amounted to 208,000 tons. Ferronickel increased its share of the domestic nickel market in 1974 at the expense of pure nickel, but nickel oxide retained its 1973 market share. The pattern of nickel consumption in 1974 changed very little from that of recent years with approximately 47% consumed in steels, 21% in other nickel and nickel alloys, and 13% in electroplating.

Changes that occurred in the U.S. supply base for nickel in 1973 became more pronounced in 1974. Imports of nickel from the U.S.S.R. continued to increase and were nearly three times those of 1973. Next to Canada, the principal U.S. supply sources for nickel were New Caledonia, the Dominican Republic, Norway, the United Kingdom, and the U.S.S.R. The United States imported a record 220,655 tons of nickel in 1974.

The prices of various primary forms of nickel showed considerable upward movement during 1974. Yearend prices for the major primary forms were as follows: Electrolytic, $2.01 per pound; FN3, FN4, and FNC, $2.02, $1.98, and $2 per pound, respectively; and domestically produced ferronickel, $1.97 per pound.

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[1] Physical scientist, Division of Ferrous Metals.

Table 1.—Salient nickel statistics
(Short tons)

	1970	1971	1972	1973	1974
United States:					
Mine production[1]	15,933	17,086	16,864	18,272	16,618
Plant production:					
Primary	15,558	15,654	15,731	13,895	14,093
Secondary	23,159	r 26,836	35,926	r 32,629	20,930
Exports (gross weight)	31,456	26,143	21,671	22,070	30,442
Imports for consumption	156,252	142,183	r 173,978	r 190,418	220,655
Consumption	155,719	128,802	159,286	197,728	208,409
Stocks Dec. 31: Consumer	24,708	16,005	26,260	r 28,759	45,284
Price cents per pound	128–133	133	133–153	153	153–201
World: Mine production	692,710	702,027	r 673,817	r 757,366	825,723

r Revised.
[1] Mine shipments.

DOMESTIC PRODUCTION

The Hanna Mining Co. at Riddle, Oreg., was the sole U.S. producer of primary nickel in 1974. Byproduct nickel salts and metal were produced at copper and other metal refineries; part of the byproduct nickel originated from scrap. Amax Nickel Division of AMAX, Inc. began production of nickel late in 1974 at its rehabilitated nickel-copper refinery at Port Nickel, La. The first 40-ton shipment of nickel-copper matte produced in Botswana was shipped to Port Nickel in March. The principal products will be nickel briquets, copper, and cobalt. Interest in the possible development of copper-nickel deposits in northeastern Minnesota remained high throughout 1974. Numerous hearings were held and environmental reports produced dealing with controversies over developing the deposits. The International Nickel Co. of Canada, Ltd. (INCO), asked for and received permission from the U.S. Forest Service to mine 10,000 tons of copper-nickel ore from Federal lands southeast of Ely, Minn. The ore was to be shipped to INCO's Canadian facilities for testing. Near yearend AMAX Exploration, Inc., was seeking approval to dig a 1,700-foot-deep test shaft near Babbitt, Minn. A task force formed by the Minnesota Environmental Quality Council (EQC) began a study of the potential impact of copper-nickel mining in Minnesota. The interagency task force estimated that 3 years would be required to complete the study.

Table 2.—Primary nickel produced in the United States
(Short tons)

	1970	1971	1972	1973	1974
Byproduct of metal refining	2,909	2,581	2,505	958	873
Domestic ore	12,649	13,078	13,226	12,937	13,220

Table 3.—Nickel recovered from nonferrous scrap processed in the United States, by kind of scrap and form of recovery
(Short tons)

Kind of scrap	1973 [r]	1974
New scrap:		
Nickel-base	1,403	1,054
Copper-base	3,996	4,224
Aluminum-base	673	627
Total	6,072	5,905
Old scrap:		
Nickel-base	25,557	14,040
Copper-base	637	598
Aluminum-base	363	387
Total	26,557	15,025
Grand total	32,629	20,930

Form of recovery	1973 [r]	1974
As metal	1,358	1,230
In nickel-base alloys	1,192	1,272
In copper-base alloys	11,137	7,400
In aluminum-base alloys	844	980
In ferrous and high-temperature alloys [1]	18,025	10,015
In chemical compounds	73	33
Total	32,629	20,930

[r] Revised.
[1] Includes only nonferrous nickel scrap added to ferrous high-temperature alloys.

CONSUMPTION AND USES

The domestic nickel industry in 1974 continued to consume a proportionately greater amount of ferronickel than in previous years. In 1974, ferronickel accounted to 22% of the total nickel consumed compared with 18% in 1973 and 14% in 1972. Most of the ferronickel was consumed in stainless and alloy steels. Pure nickel accounted for 59% of the total nickel consumed in 1974 compared with 62% in 1973 and 69% in 1972. Principal consumption of pure nickel occurred in the production of nickel wrought products and nickel alloys, electroplating, stainless steel, and superalloys. The pattern of nickel consumption in 1974 was as follows: 35% in stainless and heat resisting steel, 21% in other nickel and nickel alloys, 13% in electroplating, 11% in alloy steel, and 6% in superalloys.

Consumption of nickel in 1974 was spurred on by strong demand for nickel-bearing alloys from chemical-processing and energy-related industries and turbine engine manufacturers. Turbine engines have found increased usage in marine applications, standby electrical-power-generation equipment, and pipeline transmission pumps. Reportedly, usage of nickel-bearing stainless steel in automobiles increased in 1974, with the single largest application being in wheel covers. Other new and innovative uses of stainless steel in automobiles were in valves and levers that make up the early fuel evapcration (EFE) system being used on General Motors Corp. cars. Also more extensive use was made of stainless steelclad brakeline tubing during 1974.

Table 4.—Stocks and consumption of new and old nickel scrap in the United States in 1974

(Gross weight, short tons)

Class of consumer and type of scrap	Stocks, beginning of year	Receipts	Consumption			Stocks, end of year
			New	Old	Total	
Smelters and refiners:						
Nickel and nickel alloys	1,736	2,440	783	1,724	2,507	1,669
Monel metal	379	2,438	664	1,741	2,405	412
Nickel silver[1]	489	3,790	431	3,096	3,527	752
Cupronickel[1]	267	488	--	676	676	79
Nickel residues	3,448	5,045	6,225	--	6,225	2,268
Total	5,563	9,923	7,672	3,465	11,137	4,349
Foundries and other manufacturers:						
Nickel and nickel alloys	7,868	8,128	--	11,507	11,507	4,489
Monel metal	17	129	--	130	130	16
Nickel silver[1]	2,682	24,957	21,997	7	22,004	5,635
Cupronickel[1]	1,036	14,372	13,933	--	13,933	1,475
Nickel residues	130	518	181	377	558	90
Total	8,015	8,775	181	12,014	12,195	4,595
Grand total:						
Nickel and nickel alloys	9,604	10,568	783	13,231	14,014	6,158
Monel metal	396	2,567	664	1,871	2,535	428
Nickel silver[1]	3,171	28,747	22,428	3,103	25,531	6,387
Cupronickel[1]	1,303	14,860	13,933	676	14,609	1,554
Nickel residues	3,578	5,563	6,406	377	6,783	2,358
Total	13,578	18,698	7,853	15,479	23,332	8,944

[1] Excluded from totals because it is copper-base scrap, although containing considerable nickel.

Table 5.—Nickel (exclusive of scrap) consumed in the United States, by form

(Short tons)

Form	1970[1]	1971[1]	1972[1]	1973[1]	1974[1]
Metal	112,825	95,639	110,422	121,821	123,996
Ferronickel	15,230	11,515	22,806	36,371	45,661
Oxide powder and oxide sinter	21,369	16,554	19,315	33,257	33,617
Salts	3,792	2,376	3,939	3,668	2,026
Other	2,503	2,718	2,804	2,606	3,109
Total	155,719	128,802	159,286	197,723	208,409

[1] Metallic nickel salts consumed by plating industry are estimated.

Table 6.—U.S. consumption of nickel (exclusive of scrap) in 1974, by use and form

(Short tons)

Use	Commercially pure unwrought nickel	Ferro-nickel	Nickel oxide	Nickel sulfate and other nickel salts	Other forms	Total of figures shown
Steel:						
Stainless and heat-resisting	16,027	36,517	21,085	--	127	73,756
Alloys (excludes stainless)	6,545	6,963	9,674	--	88	23,270
Superalloy	11,814	590	74	--	514	12,992
Nickel-copper and copper-nickel alloys	9,190	--	30	22	41	9,283
Permanent magnet alloys	4,350	758	189	--	3	5,300
Other nickel and nickel alloys	42,035	413	1,252	7	375	44,082
Cast irons	2,618	417	723	--	1,515	5,273
Electroplating [1]	24,623	--	31	1,580	2	26,236
Chemicals and chemical uses	1,388	--	237	268	71	1,964
Other uses [2]	5,406	3	322	149	373	6,253
Total reported by companies canvassed and estimated	123,996	45,661	33,617	2,026	3,109	208,409

[1] Based on monthly estimated sales to platers.
[2] Includes batteries, ceramics, and other alloys containing nickel.

Table 7.—Nickel (exclusive of scrap) in consumer stocks in the United States, by form

(Short tons)

Form	1972	1973 [r]	1974
Metal	18,516	11,858	25,789
Ferronickel	3,959	7,735	11,514
Oxide powder and oxide sinter	2,806	8,018	6,289
Salts	477	466	465
Other	502	682	1,227
Total	26,260	28,759	45,284

[r] Revised.

Table 8.—Consumption, stocks, receipts, shipments and/or sales of secondary nickel in 1974 by use

(Short tons)

Use	Receipts	Consumption	Shipments or sales	Stocks end of year
Steel (stainless and heat-resisting and alloy)	44,966	41,768	1,793	5,447
Nonferrous alloys (super, nickel-copper and copper-nickel, permanent magnet and other nickel)	6,898	6,491	51	981
Foundry (cast irons)	85	76	--	14
Chemicals (catalysts, ceramics, plating salts and other chemical uses)	W	W	--	W
Other [1]	1,363	1,250	10	226
Total reported by companies canvassed and estimated	53,312	49,585	1,854	6,668

W Withheld to avoid disclosing individual confidential data; included with other uses.
[1] Includes companies that consume nickel bearing scrap in more than one end use category.

PRICES

The producers' price for electrolytic nickel showed considerable upward movement during 1974. Prices increased from $1.53 per pound to $1.62 per pound on January 4. Falconbridge Nickel Mines, Ltd. (Falco) raised the price to $1.85 per pound on May 16; INCO followed on June 28. Falco again raised the price to $2.05 per pound on December 1; INCO responded by raising the price to $2.01 per pound on December 20. Domestically produced ferronickel was increased on January 4 to $1.53 per pound of contained nickel and again on May 16 to $1.81 and finally on December 27 to $1.97. Price increases for domestically produced ferronickel reflected increased costs in labor, materials, and supplies according to a Hanna Mining Company spokesman. The price of foreign-produced ferronickel was increased several times during 1974. The new prices effective October 18 were as follows: FN4, $1.98 per pound nickel content; FN3, $2.02 per pound nickel content; and FNC, $2 per pound nickel content.

FOREIGN TRADE

U.S. exports of nickel, nickel alloys, and catalysts were 53% more than those of 1973. The quantity of exported nickel waste and scrap remained virtually unchanged from that of 1973, but the value of 1974 exported scrap increased by 34% over that of 1973.

Record quantities of nickel were imported in 1974, and exceeded 1973 imports by 16%. Canada again dominated as the principal supplier in 1974 and accounted for 58% of the total nickel imported for consumption. Other major countries supplying the United States with nickel, in decreasing order of magnitude, were the Dominican Republic, New Caledonia, Norway, the United Kingdom, and the U.S.S.R. These countries in combination with Canada accounted for 92% of U.S. nickel imports in 1974. Imports of ferronickel (gross weight) continued to gain a larger portion of the total nickel imports and accounted for 33.7% of the total in 1974 compared with 32.7% in 1973.

Table 9.—U.S. exports of nickel and nickel alloy products, by class

Class	1972		1973		1974	
	Quantity (short tons)	Value (thousands)	Quantity (short tons)	Value (thousands)	Quantity (short tons)	Value (thousands)
Unwrought	2,178	$6,469	3,764	$10,549	3,174	$11,522
Bars, rods, angles, shapes, sections	2,140	9,038	1,949	9,647	3,852	21,290
Plates, sheets, strip	3,455	16,625	3,827	20,470	8,524	49,857
Anodes	481	1,490	752	2,400	543	2,066
Wire	553	2,638	697	3,818	1,117	6,056
Powder and flakes	341	2,800	514	4,818	571	6,037
Foil	11	28	11	61	19	56
Catalysts	2,578	6,794	2,478	6,584	3,477	9,143
Tubes, pipes, blanks, fittings therefore, and hollow bars	1,499	8,831	1,825	9,815	2,903	17,226
Waste and scrap	8,440	9,055	6,253	7,646	6,262	10,245
Total	21,671	63,768	22,070	75,808	30,442	133,498

Table 10.—U.S. imports for consumption of nickel products, by class

Class	1972		1973		1974	
	Quantity (short tons)	Value (thousands)	Quantity (short tons)	Value (thousands)	Quantity (short tons)	Value (thousands)
Ore	258	$6	8,207	$190	62	$2
Unwrought	125,364	330,825	120,083	343,494	137,314	450,342
Oxide and oxide sinter	5,988	12,038	6,301	13,466	6,449	15,081
Slurry [1]	28,222	57,085	[r] 38,749	[r] 81,851	42,999	96,959
Bars, plates, sheets, anodes	198	683	[r] 267	[r] 1,164	342	1,665
Rods and wire	694	2,964	790	3,959	696	3,722
Shapes, sections, angles	1	7	[r] 1	[r] 6	7	46
Pipes, tubes, fittings	63	314	570	2,579	265	2,013
Powder	4,499	14,109	7,196	22,770	9,316	33,344
Flakes	331	909	95	297	55	201
Waste and scrap	2,306	3,517	2,642	3,906	3,699	8,545
Ferronickel	51,741	35,857	89,780	70,532	102,430	87,255
Total (gross weight)	219,665	458,314	[r] 274,681	[r] 544,214	303,634	699,175
Nickel content [e]	[r] 173,978	XX	[r] 190,418	XX	220,655	XX

[e] Estimated. [r] Revised. XX Not applicable.

[1] Nickel-containing material in slurry, or any form derived from ore by chemical, physical, or any other means, and requiring further processing to recover nickel or other metals.

Table 11.—U.S. imports for consumption of new nickel products,[1] by country

(Short tons)

Country	Metal (gross weight)		Powder and flakes (gross weight)		Oxide and oxide sinter (gross weight)		Slurry and other [2]			
							1973		1974	
	1973	1974	1973	1974	1973	1974	Gross weight	Nickel content	Gross weight	Nickel content
Australia	1,974	3,427	2,265	1,866	--	--	--	--	--	--
Canada	83,974	90,476	889	4,205	6,227	6,372	[r] 38,646	[r] 30,839	35,468	27,956
Dominican Republic	406	180	--	--	--	--	--	--	--	--
Finland	97	865	--	--	--	--	--	--	--	--
France	1,312	70	2	--	40	51	--	--	--	--
French Pacific Islands	--	--	--	--	--	--	--	--	7,419	5,647
Germany, West	71	214	1	--	--	--	--	--	--	--
Japan	--	225	--	--	--	8	33	6	9	1
Mozambique	149	6	--	--	--	--	--	--	--	--
Netherlands	15	315	20	--	(3)	(3)	--	--	--	--
Norway	14,515	16,512	48	59	--	--	--	--	--	--
Rhodesia, Southern	3,944	1,902	--	--	--	--	--	--	--	--
South Africa, Republic of	3,037	3,741	330	254	--	--	--	--	--	--
Sweden	61	19	(3)	25	--	--	--	--	--	--
Switzerland	56	62	1	25	--	--	--	--	--	--
U.S.S.R	3,264	11,055	--	--	--	--	--	--	--	--
United Kingdom	7,208	8,569	3,715	2,953	14	2	70	47	59	49
Other	--	176	20	9	20	21	--	--	44	7
Total	120,083	137,314	7,291	9,371	6,301	6,449	[r] 38,749	[r] 30,892	42,999	33,660

[r] Revised

[1] Ore: 1973, Australia 113, Colombia 8,094, France less than 1 short ton; 1974 French Pacific Islands 62.

[2] Nickel-containing materials in slurry, or any form derived from ore by chemical, physical, or any other means, and requiring further processing to recover nickel or other metals.

[3] Less than ½ unit.

WORLD REVIEW

Australia.—Late in 1974, the Australian Government disclosed new guidelines for foreign equity participation as it relates to control of the mining industry in Australia. The guideline's basic aim was to insure that the mineral resources of Australia were developed and that maximum benefits accrued to the Australian people. Thus, all mining enterprises must conform with the national interest. A major objective will be to promote Australian equity in and control of its resources and industries. The Government desires maximum Australian ownership of all mining enterprises engaged in exploration, development, or processing. The Government also prefers both public and private participation in mining operations. The Australian Minister for Minerals and Energy requested that he be informed of all major mineral proposals, whether by Australian or foreign enterprises, early in the development stages.[2]

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[2] American Metal Market. Australia Lists Rules for Foreign Participation in Mining Industry. No. 22, v. 81, Nov. 21, 1974, p. 6.

Table 12.—Nickel: World mine production,[1] by country
(Short tons)

Country [2]	1972	1973	1974 [p]
Albania [e]	6,600	6,600	6,600
Australia (content of concentrate)	39,185	44,308	44,500
Botswana [e]	--	100	1,000
Brazil (content of ore)	3,746	[r] [e] 3,900	[e] 3,900
Burma (content of speiss)	29	23	24
Canada [3]	258,987	274,527	299,661
Cuba (content of oxide and sulfide) [e]	35,000	35,000	35,000
Dominican Republic	19,200	33,200	[e] 33,000
Finland:			
Content of concentrate	5,687	6,371	6,600
Content of nickel sulfate	211	243	[e] 245
Greece (recoverable content of ore)	[r] 21,718	28,940	[e] 27,600
Indonesia (content of ore) [4]	24,738	22,946	[e] 23,000
Mexico (content of ore)	19	35	[e] 40
Morocco (content of nickel ore and cobalt ore)	220	330	[e] 4,400
New Caledonia (recoverable) [5]	[r] 98,016	120,506	[e] 142,800
Norway (content of concentrate)	425	512	635
Philippines [e]	423	440	6,600
Poland (content of ore) [e]	[r] 1,700	[r] 1,700	1,700
Rhodesia, Southern (content of concentrate) [e]	13,200	18,000	13,200
South Africa, Republic of	12,849	21,413	[e] 23,600
U.S.S.R. (content of ore) [e]	[r] 115,000	[r] 125,000	[r] 135,000
United States (content of ore shipped)	16,864	18,272	16,618
Total	[r] 673,817	757,366	825,723

[e] Estimate. [p] Preliminary. [r] Revised.

[1] Insofar as possible, this table represents mine production of nickel; where data relate to some more highly processed form, the figures given have been used in lieu of unreported actual mine output to provide some indication of the magnitude of mine output, and are so noted, parenthetically, following the country name.

[2] In addition to the countries listed, East Germany also produces nickel from mines, but output is not reported quantitatively and available information is inadequate for formulation of estimates of output levels.

[3] Refined nickel and nickel content of oxides and salts produced, plus recoverable nickel in exported mattes and speiss.

[4] Includes a small amount of cobalt not reported separately.

[5] Nickel-cobalt content of metallurgical plant products, plus recoverable nickel-cobalt in exported ores.

Table 13.—Nickel: World smelter production,[1] by country [2]
(Short tons)

Country [2]	1972	1973	1974 [p]
Australia	18,200	24,300	[e] 24,500
Botswana [3]	--	--	[e] 720
Brazil [4]	2,978	[e] 3,100	[e] 3,100
Canada [4]	[r] 147,656	165,546	195,112
Cuba [e] [4]	[r] 20,000	[r] 20,000	20,000
Czechoslovakia [e]	900	900	900
Dominican Republic [5]	19,200	33,200	[e] 33,100
Finland	6,016	6,436	[e] 6,500
France	14,409	12,000	[e] 10,600
Germany, West	220	--	--
Greece	12,500	15,300	[e] 17,900
Japan [6]	87,600	96,700	115,000
New Caledonia [7]	61,983	63,091	74,263
Norway	47,739	47,075	47,730
Philippines	--	--	[e] 1,600
Poland [e]	1,700	1,700	1,700
Rhodesia, Southern [e] [4]	11,000	11,000	11,000
South Africa, Republic of [4]	11,000	16,500	24,400

See footnotes at end of table.

Table 13.—Nickel: World smelter production,[1] by country—Continued
(Short tons)

Country [2]	1972	1973	1974 [p]
United Kingdom	35,200	40,600	[e] 35,900
U.S.S.R. [e]	140,000	150,000	160,000
United States: [8]			
Byproduct of metal refinery	2,505	958	873
Recovery from domestic ore	13,226	12,937	13,220
Total	[r] 654,032	721,348	798,118

[e] Estimate. [p] Preliminary. [r] Revised.

[1] Refined nickel plus nickel content of ferronickel produced from concentrates unless otherwise specified.

[2] In addition to the countries listed, East Germany and North Korea are believed to produce metallic nickel and/or ferronickel, but information is inadequate for formulation of reliable estimates of output levels.

[3] Nickel content of nickel-copper-cobalt matte produced and shipped to the United States for refining. Refined nickel recovered from this matte is not included with U.S. production.

[4] Includes nickel content of nickel oxide and nickel fonte in addition to metallic nickel and ferronickel.

[5] Nickel content of ferronickel only. (No refined nickel is produced.)

[6] Includes electrolytic nickel as follows in short tons: 1972—18,189; 1973—23,249; 1974—22,969; the difference between these figures and the listed total is the nickel content of ferronickel, nickel oxide and nickel fonte.

[7] Nickel-cobalt content of ferronickel and matte.

[8] Electrolytic nickel from sources specified only; excludes electrolytic nickel produced from imported matte (see footnote 3) as well as nickel content of ferronickel and fonte.

Western Mining Corp., Ltd., the world's fourth largest nickel producer among market economy countries, continued its expansion programs during 1974. During the year, production at Kambalda was increased, and in September, production began at the Windarra mine, which Western Mining jointly owns with Poseidon Ltd. Planned capacity at Windarra is expected to be 14,000 tons per year of contained nickel. Expansion of the Kalgoorlie nickel smelter was at an advanced stage late in 1974. The smelter capacity was to be expanded to about 38,500 tons of nickel per year in matte. Western Mining also was expanding the capacity of the Kwinana refinery to 33,000 tons per year of refined nickel. The expansion entailed construction of additional ammonia and hydrogen plants and installation of another autoclave and supporting equipment. Additional exploration at Kambalda and in the Paris-St. Ives area near Lake Lefroy resulted in the discovery of additional nickel mineralization. New reserve estimates for this area in Western Australia were 24.6 million tons of ore averaging 3.22% nickel.

Selcast Exploration Ltd. became the fourth company in Australia to develop nickel deposits. Spokesmen for the company estimated reserves at 880,000 tons of ore averaging 2.4% nickel near Spargoville. Selcast planned to sell its entire output of nickel concentrate to Western Mining. Deliveries were expected to start early in 1975 and continue until mid-1978. Purchase of the concentrate from Selcast was to coincide with production startup at the Poseidon-Western Mining Windarra nickel mine in Western Australia. The two operations were expected to boost Western Mining's nickel output approximately 50%.

The Greenvale nickeliferous laterite project in Queensland was to be completed by the end of December 1974, and shipments were expected to begin in January 1975 on a limited basis. Early in 1974, estimated direct operating costs for producing nickel and cobalt were raised from the original 50 cents per pound of nickel-cobalt to 65 cents per pound of nickel-cobalt. Company officials attributed the increase in cost to revaluation of the Australian dollar, a rapid rate of inflation in Australia, and drastic increases in fuel oil prices. Reportedly, 40,000 tons per year of Bunker C fuel oil will be consumed in processing the ore. After the ore has been crushed and ground, it will be mixed with 4% heavy fuel oil by weight. This mixture will be fired in reduction furnaces where the nickel and cobalt will be reduced to a metallic state. The reduced ore will be slurried in a solution containing ammonia and ammonium carbonate, which will dissolve the nickel and cobalt. After iron is precipitated from the solution, cobalt and nickel will be stripped by hydrogen sulfide to produce a mixed sulfide product. Nickel will be removed by steam and formed into a nickel carbonate cake. Calcining the carbonate cake with fuel oil will produce an oxide product containing 70% nickel. Treatment of the oxide in a reduction furnace with hydrogen will produce an upgraded oxide product containing 90% nickel. This product will be pressed into briquets and sintered in a nitrogen atmosphere to produce commercial-grade nickel oxide 90. At yearend, proven reserves at Greenvale were estimated at 44 million tons averaging 1.57% nickel and 0.12% cobalt.

Late in November, the Government of Western Australia signed an agreement with Western Selcast Pty. Ltd. and Mount Isa Mines, Ltd. for development of the Agnew nickel deposit located approximately 400 miles northeast of Perth. Western Selcast will have 60% interest and Mount Isa 40% in the joint venture to be managed by the newly formed Agnew Mining Co. Pty. Ltd. The project will require construction of a town to house about 3,000 people, and a mine and associated facilities for producing nickel matte. The agreement specifies that the partners will explore the possibility of establishing a nickel refinery in Western Australia within 10 years. Initially, the smelter will operate at a rate of 20,000 tons per year of nickel matte; the rate will be gradually increased to 30,000 tons per year. An Outokuompu flash smelter was selected because the unit requires only one-half to two-thirds as much fuel oil as do traditional electric smelters. Construction at Agnew was to begin about the middle of 1975, and the first nickel matte is to be produced by the end of 1977. The matte will contain 77% nickel.

Botswana.—Officials of Botswana Roan Selection Trust, Ltd. (BRST), stated that its subsidiary, Bamangwato Concessions, Ltd. (BCL), began mining ore at the end of 1973 and that small shipments of matte had been made from the smelter during 1974. The ore was mined at the Selebi-Pikwe ore bodies with a combined reserve estimated at 35.4 million tons proven and 12.8 million tons probable. BCL's production was delayed because of technical problems in the smelter's spray dryer at the surface treatment plant. The initial production of copper-nickel matte was to be toll refined at Amax Nickel Division's Louisiana refinery persuant to a 15-year refining agreement.

Brazil.—INCO entered into a participation agreement with a West German consortium comprised of Metallgesellschaft AG. of Frankfurt and Exploration und Bergbau GmbH of Düsseldorf to develop lateritic nickel deposits at Barro Alto in the state of Goiás, Brazil. The Brazilian company, Baminco Mineração e Siderúrgia S.A. (BAMINCO), holds rights to the mining concessions at the Barro Alto deposits. The company has conducted geological and metallurgical work since 1970. BAMINCO was to mine a bulk sample of ore and ship it to INCO's Port Colborne, Ontario, Canada, pilot plant for testing in 1974. Under an agreement submitted to the Brazilian Government in December 1972, and approved in May 1973, INCO and the West German group were to have equal interests in the project and in BAMINCO.

Burundi.—Nickel deposits were discovered in Burundi by a United Nations minerals survey team in 1973. Members of the team reported the nickel deposits as being significant. Nevertheless, major problems must be overcome if and when the deposits are proven to be exploitable. Large infrastructure costs would be incurred in developing the deposits, and adequate access to the sea and power sources would be necessary.

Canada.—Canadian nickel production in 1974 was 9% greater than in 1973 and accounted for 36% of total world mine production. Leading producers of nickel in Canada were INCO, Falco, and Sherritt Gordon Mines, Ltd.

INCO mined a total of 22 million tons of ore averaging 1.37% nickel and 0.97% copper compared with 19.7 million tons in 1973 averaging 1.41% nickel and 0.98% copper. The company produced a record high of 510 million pounds of nickel in 1974 compared with 469 million pounds in 1973. INCO initiated a new program in 1973 to expand the output of nickel in Canada and continued it through 1974. Annual production of nickel in 1975 is expected to exceed 520 million pounds. Company officials indicated that increased production in 1974 was due to improved underground operating efficiencies. INCO operated 16 mines during 1974, 13 in Ontario and 3 in Manitoba while maintaining 2 mines in Ontario and 1 in

Manitoba on standby. Production of nickel ore from the Crean Hill mine was resumed in January 1974. Preparatory work at the Clarabelle open pit mine in Sudbury was completed in December 1974; and mining was to resume at a later date. The Copper Cliff nickel refinery completed its first full year of operation in 1974, but did not achieve full capacity owing to problems with preparation of feed material. INCO was attempting to overcome this problem by increasing the capacity of the top-blown rotary converter plant in order to equal the designed 125 million pounds capacity of the carbonyl plant. According to company officials, operation of the 1,250-foot smelter chimney along with technological improvements in the Sudbury operations, have improved air quality in the region. Construction on two waste-water treatment plants in the Sudbury area was begun in 1974; these plants were to be operational in 1975. INCO officials reported proven ore reserves in Canada of 414 million tons at the end of 1974, containing 6.7 million tons of nickel and 4.2 million tons of copper. This compared with 399 million tons at the end of 1973, containing 6.5 million tons of nickel and 4.1 million tons of copper.

Falco mines delivered 4,337,000 tons of nickel ore to treatment plants in 1974 compared with 4,293,000 tons delivered in 1973. Nevertheless, deliveries of refined nickel decreased from 49,704 tons in 1973 to 44,732 tons in 1974. Development of the Lockerby mine continued through 1974. At yearend, the No. 2 shaft had reached the 4,200-foot level. Ore production from Lockerby was expected to reach one-third the rated maximum output in the last quarter of 1975. The ore will be shipped to the Strathcona mill for processing. Enlargement of the Strathcona mill was near completion at yearend. Development of other Falco mines in the Sudbury area continued throughout 1974 with the sinking of additional shafts. Ore production from the Manibridge mine in Manitoba was increased from 136,000 tons in 1973 to 184,000 tons in 1974. Temporary shutdowns of short duration were encountered during 1974 to alleviate temporary peaks in the emission of sulfur dioxide and as a result of coke shortages. Falco began work on a smelter environmental improvement program at Sudbury in 1974. The project, to include a sulfuric acid plant, will cost an estimated $95 million. Falco reached a settlement early in 1974 regarding financial claims on its nickel-iron pellet refinery. The company's total proven and probable ore reserves at the Sudbury and Manibridge operations at the end of 1974 were 90,578,000 tons containing 1,266,000 tons of nickel and 615,000 tons of copper compared with 92,798,000 tons of ore containing 1,271,000 tons of nickel and 632,000 tons of copper at yearend 1973.

Sherritt Gordon, Canada's third-largest producer of nickel, experienced some difficulty with its Lynn Lake nickel-copper-cobalt mine as a result of lagging ore production. According to company officials, principal reasons for reduced output were excess dilution of the ore from some of the open blasthole stopes and a shortage of experienced miners. Giant Mascot Mines, Ltd., which was shipping ore to Sherritt Gordon for refining, reportedly exposed a new zone of mineralization at its Giant Nickel property in British Columbia. The mineralization was exposed when a new road was constructed by a logging company across land on which Giant Mascot owned the mineral rights. At yearend, no indication was given as to the extent of the mineralization.

Sales, deliveries, or production, as reported by the three principal Canadian producers in 1974, were as follows:

Company	Type of operation	Thousand pounds
The International Nickel Co. of Canada, Ltd	Delivery	549,000
Falconbridge Nickel Mines, Ltd	do	89,464
Sherritt Gordon Mines, Ltd	Sales	16,142

After considerable drilling, feasibility and engineering studies, mine planning, and expense (estimated at $10 million), Great Lakes Nickel, Ltd., of Canada and Boliden A.B. of Sweden suspended development of their joint nickel-copper mining venture near Thunder Bay, Ontario. According to company officials, the $38 million project was placed on standby because of cost escalations, high interest rates, and unstable metal prices. Indicated reserves were 106 million tons averaging 0.4% copper and 0.2% nickel. Hollinger Mines, Ltd. continued an exploratory drilling program at its coowned nickel-copper prospect near Timmins, Ontario. Reportedly, test samples averaged 0.23% copper and 0.35% nickel. Other companies associated with this venture were Imperial Oil, Ltd. (Exxon Corp.) with a 42.5% share equal to that of Hollinger; the remaining 15% was equally divided among Dome Mines Ltd., Jorex Ltd., and Driftex Ltd.

Cuba.—The Cuban Government's program to increase production at the Nicaro and Moa Bay nickel operations, and the opening of a new mine (Punta Gorda) and three processing plants in Oriente Province would cost an estimated $350 to $450 million. Of the total investment, $300 to $400 million was earmarked for the new operations. The capacity of each plant would be 33,000 tons per year of nickel contained in nickel oxide sinter pellets. Reportedly, the pellets will contain 77% nickel and 3% cobalt. Government officials reported that feasibility studies and preproject planning for the new mine, water supplies, powerplants, and railway and port facilities have been completed. Construction was to begin by 1976–77 with planned startup of one plant scheduled for late 1978. The remaining two plants would begin operating between 1980 and 1985. Ore grade in the area of the three plant sites was reported to be 1.37% to 1.4% nickel. The ore was to be mined by open pit techniques. Approximately $40 million of the investment was to be spent on the Nicaro operation to modernize equipment and bring production up to the full designed capacity of 23,000 tons. The remaining $10 million was to be spent on the Moa Bay operation to upgrade processing facilities. Reportedly, the capacity at Moa Bay will not be increased.

Cuba uses very little of the total amount of nickel it produces annually. The U.S.S.R. purchases nearly 50% of the output; Czechoslovakia, Romania, France, England, Italy, and Japan take the remainder.

Dominican Republic.—Falconbridge Dominicana C. por A. achieved full designed production capacity in March 1973. Increased fuel oil prices, as reflected in production costs, affected Falconbridge Dominicana's contribution to the company's overall consolidated earnings. The total effect of oil price increases was partially offset by operational economies and plant modifications. Price increases for ferronickel that were announced during 1974 were expected to yield a limited benefit to company profits for the year 1974. Although deliveries of ferronickel through the first 6 months of 1974 were 18% greater than for a similar period of 1973, company officials reported that deliveries in the second half would be less in order to restore producer ferronickel inventories to more normal levels. Falconbridge Dominicana was successful in negotiating a 3-year labor contract in November 1973, which provided the employees with increased salaries and benefits.

Guatemala.—Good progress was reported on the development of nickel deposits located near Lake Izabal in eastern Guatemala. Site preparation for the plant and town had been underway for some time and was nearing completion. The development company known as Exploraciones y Explotaciones Mineras Izabal, S.A. (Exmibal), was 80% owned by INCO and 20% by Hanna. Reportedly, provisions were made for the Government of Guatemala, the International Finance Corp., and the Central American Bank for Economic Integration to acquire up to 36% of Exmibal. A peak force of 1,200 people were to be employed during the construction phase and 700 people employed to operate the plant.

India.—Reportedly, the Indian Government gave approval to develop the Sukinda nickel project in the State of Orissa. The nickel lateriate deposit was estimated to contain 65 million tons of ore having an average nickel content of 0.85%. Planned capacity was 4,800 tons of nickel and 200 tons of cobalt per year. Government officials reported that India's demand for nickel will continue to rise from the present level of 4,800 tons to about 12,400 tons per year by 1978–79. A byproduct of the plant will be 17,000 tons of ammonium sulfate per year, undoubtedly to be used as fertilizer.

Indonesia.—P. T. International Nickel Indonesia, a wholly-owned subsidiary of INCO, in combination with six Japanese partners was proceeding with the development of a mine and processing plant in Indonesia. The facilities will produce a nickel matte containing 75% nickel from lateritic ores located near Soroaka, in central Sulawesi. Plant output is committed to three of the Japanese partners for 15 years. Improvement of the pyrometallurgical process to which the ores will be subjected has permitted an upward revision of output projections from 30 to 35 million pounds of nickel annually. Development of the project will require a peak employment of 1,300 people in 1975, and will stabilize at approximately 1,100 when the plant and mine are in production. The company continued to explore the possiblity of expanding production to 90 or 100 million pounds of nickel annually at a later date. Also being considered by the company was an option to use the hydroelectric potential of the area rather than relying on petroleum as the project's energy source. Reportedly, INCO held 18% of the original 6.6-million-hectare contract area and was continuing its systematic exploration program. Dravo Corp. holds the engineering and construction contract for the complex. Dravo's contract included construction of port facilities (already begun), supporting utilities, a town site, roads, a cross-country pipeline, and the plant itself, which is to be equipped with a top-blown rotary converter. Davy Ashmore International of the United Kingdom was to supply the top-blown rotary converter for the plant. At yearend, the project was still scheduled for startup in 1976.

P. N. Aneka Tambang (ANEKA), a state-owned mining company, was the only producer of nickel in Indonesia during 1974. The company exported ores to Japan from its Pomelaa mine located near Kendari, in south Sulawesi. ANEKA's overall development program called for the production of ferronickel at Pomelaa, as a means of utilizing low-grade ores remaining at the site, when the exportable grades of ores become depleted. Construction of a $32 million, Japanese-financed, smelter was well underway at midyear; the company expected to be in production by early 1976. ANEKA conducted geologic mapping and test sampling of large low-grade nickel deposits in Southeast Kalimantan during much of 1974.

Engineering, design, and procurement activities have been brought to the point where infrastructure and facility construction can readily be undertaken if P. T. Pacific Nikkel Indonesia decides to proceed with the development of its giant Gag Island nickel project on Irian Barat. However, the partners in the consortium have adopted a holding position pending the resolution of fuel oil prices, supply problems and clarification of the financial terms that would be attainable for the project. At midyear, engineering and procurement activities were temporarily suspended. Nevertheless, a task force was working on construction and site preparation on Gag Island.

The Indonesian Nickel Development Co. (INDENCO), a partnership of four Japanese smelters and three trading firms, had completed initial reconaissance of its contract area in Halmahera and the surrounding islands. At midyear, INDENCO was conducting studies to establish a logistics base for its operation. Reportedly, the company had indications of relatively high-grade lateritic nickel ore on the Islands of Gebe and Obi.

Japan.—Japan's nearly total dependence on four countries for 90% of its nickel supply (New Caledonia, 47.1%; Canada, 18.7%; Australia, 12.4%; and Indonesia, 11.1%) was the motivating force behind a desire for stockpiling 8,800 tons of nickel. Reportedly, this quantity would give the country a 3-month supply. Other moves by Japanese firms to secure long-term supplies of nickel for their industry was evidenced by the fact that Japanese companies entered into several consortia to develop and process manganese nodules found in the Pacific Ocean. Manganese nodules are estimated to contain 1.6% nickel and other associated metals.

By mid-1975, Japan's two producers of nickel, Sumitomo Nickel Mining Co., Ltd., and Shimura Kako Co., will be joined by a third company, Nippon Mining Co., Ltd. Nippon currently has a refinery under construction for producing nickel and cobalt.

Japanese nickel smelter operators planned to hold talks with New Caledonia nickel ore shippers late in 1974 in an attempt to obtain a reduction or deferral of nickel ore shipments to Japan. The reason given for reducing shipments was a declining demand for nickel. In another move to ease what appeared to be a nickel oversupply, the Japanese Ministry of Trade and Industry (MITI) authorized increased exports of nickel ingot for the second half of the fiscal year (October to March). Reportedly, Japan was committed to import about 15,000 tons of nickel and 9,500 tons of ferronickel in addition to ores and matte in 1974. Approximately one-third of the 15,000 tons of nickel imported was to come from the U.S.S.R. under a long-term contract. Most of the remainder was shipped by INCO to Mitsui & Co., Nissho-Iwai, and Sumitomo, the rest was shipped by Falco to Mitsubishi Corp.

Japanese companies were active in numerous nickel developments, principal among these were the development of the Rio Tuba mine in the Philippines, the development of Australia's Greenvale nickel mine, the development of nickel mines in Indonesia, and sales contracts to buy nickel-cobalt sulfide from the Marinduque mine and smelter, which began producing nickel in the Philippines at yearend.

New Caledonia.—Production of nickel ore in New Caledonia in 1974 was 19% greater than that produced in 1973. Nickel smelter production increased nearly 18% in 1974 over that of 1973. Ferronickel production increased 36%, but matte production decreased 12% below that of 1973. Exports of nickel ore to Japan in 1974 increased by 19% when compared with exports in 1973. Next to France, the United States was the leading recipient of ferronickel and matte, followed in decreasing order by Japan, Canada, Finland, and Australia.

The major nickel producer, Société le Nickel (SLN), on New Caledonia concluded several major deals in 1974 that should affect nickel production on the island for many years to come. Early in 1974, SLN sought and obtained an agreement from Kaiser Aluminum & Chemical Corp. to purchase Kaiser's 50% interest in the New Caledonian Nickel Co., thus giving SLN full ownership. According to company officials, the settlement would permit SLN to reinforce its position in world nickel market, while Kaiser Aluminum could concentrate its effort on activities outside the nickel industry. A second major event occurred in March 1974 when the management of SLN announced an agreement in principal with Société Nationale des Pétroles d'Aquitaine (SNPA) to form a joint firm to handle SLN's mining and industrial assets in New Caledonia and France. Under the proposed plan, SLN would be reorganized into a holding company under the name I-Metal. Stockholders also approved the creation of a special nickel subsidiary, Société Metallurgique le Nickel. SNPA's agreement to take a 50% share in I-Metal's newly created subsidiary would depend on the Government's forthcoming tax proposal for New Caledonian nickel processors. Reportedly, SNPA made the first installment of about $20 million to the nickel subsidiary, Société Metallurgique le Nickel. According to SNPA company officials, the decision to join I-Metal would not involve any change in the company's prior decision to join with Freeport Minerals Co. in developing the Goro deposit on New Caledonia. The third major event that occurred during 1974 was the acquisition of approximately 10% of the common stock of SLN by Amax Inc. The stock acquisition by Amax made the company the second largest shareholder, after the Rothchild group's holdings of approximately 26%. According to a company official, Amax planned to purchase material from SLN for feed to its newly refinery at Port Nickel, La.

Compagnie Française d'Entreprises Mínières Métallurgiques et d'Investissements (COFREMMI), a wholly owned subsidiary of Patino N.V., obtained a "go ahead" from the French Government to establish a nickel mining and metallurgical project in northern New Caledonia. COFREMMI was to develop ore deposits in the Tiebaghi and Poum areas of New Caledonia. Proven reserves were 13 million tons of ore containing 3% nickel plus cobalt in garnierite and 17 million tons of 1% nickel plus cobalt in laterite in the Tiebaghi deposits and 35 million tons of 3.2% nickel plus cobalt in garnierite and 41 million tons of 1.34% nickel plus cobalt in laterite at Poum. Company plans called for mining the garnierite first. Société Mètallurgique de Nickel Patino Péchiney Gränges (SOMMONI), a wholly owned subsidiary of COFREMMI, was to build a ferronickel plant and produce 40 million pounds of nickel in ferronickel (35% nickel content) per year. The output may be increased to 80 million pounds per year at a later date. Work on the plant site began in December 1973 and was to be intensified in order to achieve production by the middle of 1976. Société Française d'Electrometallurgie (SOFREM), a subsidiary of Péchiney Ugine Kuhlmann, was to provide technical assistance during the first 15 years of operation. SOFREM had developed and patented an electric furnace process for treating New Caledonian ores and had completed a 12-month pilot plant test. The company was to conduct an additional 6 months of trials with a 5-megawatt semicommercial-size plant. The semicommercial plant was to be used by SOFREM for training personnel who ultimately would operate the smelter in New Caledonia.

At yearend, the French Government still had not made a decision regarding changes to New Caledonia's tax structure. Nevertheless, a decision regarding New Caledonian taxes was expected early in 1975.

Philippines.—Reportedly, Marinduque Mining & Industrial Corp.'s new nickel project on Nonoc Island in the Philippines was producing nickel for sale at yearend. According to an official of Philip Brothers, the sales agent for Marinduque, the 1975 production was practically sold out. The nickel was sold to consumers in Sweden, West Germany, the United States, the United Kingdom, France, and Austria. Major sales were made to the stainless steel and high-temperature-alloy industries. Plant capacity was rated at 75 million pounds of nickel briquets and powder, of which 8 million pounds was to be in the form of a nickel and cobalt concentrate.

Atlas Consolidated Mining & Development Corp. postponed indefinitely the development of its nickel refinery project on Palawan Island. According to company officials, the principal reason for postponing the project was the enormous increases in fuel oil costs. Tests were conducted during the year to see if coal could be used in place of fuel oil as a reductant in treating the ore.

Saturn Minerals Inc. proceeded with preliminary work for development of nickel deposits in northern Leyte. The company requested that the Philippine Bureau of Mines send a team of geologists and mining engineers to evaluate the reported 5.5 million tons of sulfide nickel ores blocked out by five drill holes. Saturn had contracted Konsulta Philippines to make a feasibility study of the project.

Rio Tuba Nickel Mining Corp. signed an agreement to supply 386,000 tons of nickel ore in 1976 and 550,000 tons during each of the succeeding 9 years to four Japanese nickel smelters. The ore would be mined from Rio Tuba's laterite nickel deposits on Palawan Island. The Japanese companies involved were Sumitomo Metal Mining Co., Nippon Mining Co., Nippon Yakin Kogyo Co., and Shimura Kako Co.

Southern Rhodesia.—Johannesburg Consolidated Investment Co. Ltd. expected to begin trial milling at its Shangani nickel mine complex by the middle of 1976. At midyear, access roads and a rail line to the main railhead had been built and surface building construction was underway. The complex was to be composed of a large concentrator, a crushing and screening plant, waterworks, and a pipeline from the Shangani Dam. Mining was to start with an open pit and later continue with a deep-level shaft and conventional underground mine. Reportedly, milling capacity would be 83,000 tons per month. Shangam ore reserves were estimated at 16 million tons. Exploration work being conducted during 1974 at nearby Damba may prove larger deposits. Trojan Nickel Mine Ltd., a wholly owned subsidiary of Rhodesian Nickel Corp. (Rhonickel), acquired nine blocks of claims to the Epoch property in the Filabusi District. Drilling indicated a potential of 2.5 million tons of ore grading 0.75% nickel. Preliminary plans call for the development of a mine shaft and plant to produce nickel concentrate. Reportedly, the Epoch concentrates would be treated along with concentrates from the Shangani mine at Rhonickel's refinery at Bindura.

U.S.S.R.—Late in 1974,, the U.S.S.R. signed a contract with Finland for the delivery of copper and nickel smelting equipment to Norilsk, Siberia. The plants were based on the Outokumpu flash-smelting process and were to be delivered in 1976–77. Outokumpu Oy was to handle the engineering and design automation of the smelters, Rauma-Repola Oy was responsible for the flash-smelting furnaces, concentrate drying equipment, and sulfur-recovery systems; and A. Ahlstrom Oy would supply the boilers and gas purification equipment for the overall process. Reportedly, plant capacities were to be 550,000 tons per year of nickel concentrate and 650,000 tons per year of copper concentrate.

Yugoslavia.—Approximately $300 million was to be invested in the development of a nickel mine and ferronickel plant at Kavadarci, Macedonia. Feni Kombinat was the Yugoslavian company developing the 110 million ton lateritic ore deposit. The mine was to produce 2.2 million tons per year of ore with the nickel plant producing 18,150 tons of nickel and 660,000 tons per year of iron concentrates. The nickel smelter is expected to be operational by 1979.

TECHNOLOGY

Bureau of Mines scientists continued an active research program on nickel recovery from various domestic ores during 1974. The Bureau's research on nickel was being conducted at four metallurgy research centers and dealt with the recovery of nickel from western (Oregon and California) lateritic ores, the Duluth gabbro in Minnesota, and Missouri lead ores. A research project was initiated in July 1974 to investigate the recovery of metals from nodules found on the Blake Plateau in the Atlantic Ocean.

Bureau of Mines scientists reported on the development and application of the waste-plus-waste process for recovering metals from electroplating solutions and other wastes.[3] The method was based on combining various acid and alkaline wastes under controlled conditions so as to neutralize the wastes while precipitating nearly all of the contained metals and cyanides. The process was believed to be suitable for treating major types of electroplating and etching wastes containing cadmium, chromium, copper, nickel, and zinc. Economics of the process were reported to be good while providing a relatively harmless filtrate that met Public Health Service standards for free cyanide content. In a second report,[4] Bureau chemists described their findings regarding stability constants for complexes of diethylenetriamine, 2-aminoethyl sulfide, triethylenetetramine, and 1, 8- diamino-3, 6-dithiaoctane with copper, nickel, zinc, and cadmium. Amine complexes were found to be considerably more stable than the analogous thio complexes. The authors interpreted their findings in terms of possible molecular structure of the complexes.

An international consortium was formed during 1974 to exploit a new process for continuous production of nickel, copper, and lead from sulfide concentrates.[5] The process was co-invented by Drs. Paul E. Queneau of Dartmouth's Thayer School of Engineering and Rheinhardt Schuhmann, Jr. of Purdue University. The Q–S (Queneau-Schuhmann) Process is performed in a single-reaction vessel that is continuously fed oxygen, concentrates, and flux. The net result is a controlled flash oxidation of the sulfide concentrates. Oxygen is fed upward through the molten material by passing it through the refractory lining of the vessel. This marks the first time that such a technique has been applied in nonferrous converting operations. Universal Oil Products Co. (UOP) announced tentative plans to build a $1.6 million pilot plant to demonstrate its new process for extracting nickel from lateritic ores.[6] Spokesman for UOP stated that the process is the first hydrometallurgical one capable of economically processing a variety of lateritic ores. Reportedly, the key to UOP's process is improved ore reduction that permits a recovery of 90% of the nickel in laterite ores.

Scientists at Cabot Corp's Stellite Division discovered a method for producing superalloy ball bearings utilizing powder metallurgy techniques.[7] Powder metallurgy permits the formation of fully dense balls of cobalt-, nickel-, and iron-based superalloys. Bearings thus formed have crush strengths several times greater than cast bearings with a wear life many times greater. Reportedly, material savings of up to 60% are possible through the use of powder metallurgy. A research metallurgist at the NASA Lewis Research Center formulated a new high-strength nickel-based alloy (WAZ–16)that has a higher incipient melting temperature than other nickel-based alloys.[8] The high strength of the alloy is most significant between 1,100° and 1,200° C. It possesses a higher oxidation resistance than other refractory metals. Reportedly, the alloy will have applications in heat-treating furnace fixtures, jet engine components, and power-generating turbine components.

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[3] Cochran, A. A., and L. C. George. Development and Application of the Waste-Plus-Waste Process for Recovering Metals From Electroplating and Other Wastes. BuMines RI 7877, 1974, 18 pp.

[4] May, A., and D. J. MacDonald. Stability Constants of Metal Coordination Compounds. BuMines RI 7825, 1974, 12 pp.

[5] Journal of Metals. Form Consortium To Exploit New Q–S Process. V. 26, No. 3, March 1974, p. 12.

[6] Chemical Week. Betting on Chemical Systems To Win More Nickel. V. 115, No. 17, Oct 23, 1974, p. 57.

[7] Industrial Research. Superalloy Ball Bearing Made by Powder Metallurgy. V. 16, No. 10, October 1974, p. 57.

A noteworthy development was announced by scientists at General Electric Co. that involved a possible ceramic substitute for certain types of superalloys.[9] Through the use of special additives, ceramic materials can be sintered to high densities without the use of pressure. The simple procedure permits the formation of complex silicon carbide shapes by extrusion, die pressing, slip casting, and injection molding. Researchers at General Electric foresee the initial use of the ceramic as a structural material for high-temperature gas turbine components that would allow the development of more efficient propulsion and power-generation systems. The material apparently has physical characteristics that would allow it to replace some superalloys.

INCO metallurgists continued investigations into corrosion-resistant alloys at the Francis L. La Que Corrosion Laboratory near Wilmington, N.C., and conducted research on the production and utilization of various nickel alloys at the Paul D. Merica Research Laboratory at Sterling Forest, N.Y. The Merica laboratory recently developed a copper-nickel wire-mesh catalyst for controlling automotive exhaust emissions. The catalyst was being tested by a major automotive parts manufacturer at yearend. If successful, the catalyst would be changed much like an automobile oil filter is changed today. Another recent development by INCO was the formulation of a nickel-magnesium alloy (Incomag 4) used to introduce magnesium into molten iron and steel in producing ductile iron. Inco-Mag 4 is added in the form of heavy pieces and, as such, sinks to the bottom of the furnace. The magnesium is then absorbed by the molten iron and magnesium recovery rates of 80% to 90% are achieved.

Officials of Questor Corp. announced the development of a nickel-based catalyst for controlling automobile emissions that can be used with leaded gasoline. The system would require about 2 pounds of nickel per automobile and cost about $125.[10] The basic nickel alloys are Inconel 601 and a reduction catalyst IN–1013, both supplied by INCO. The catalyst was undergoing tests on various automobiles at yearend.

Reportedly, a potential market for an estimated 30 million pounds of a newly developed alloy IN–838 may exist in uses ranging from marine condensers to power-generating equipment.[11] Company officials stated that the alloy provides superior performance in situations where metal is subjected to high-velocity flows of salt water. IN–838 is a chromium-modified 16% nickel cupronickel alloy.

A large number of patents relating to nickel were issued in 1974, with the main thrust being toward pyrometallurgical and hydrometallurgical extraction procedures. Numerous patents were issued on refining techniques that ranged from chemical precipitation to electrolytic refining. Interest remained high in the recovery of metals, including nickel from seabed nodules, as evidenced by the number of patents issued in 1974. A novel patent was issued to Barringer Research Ltd.[12] covering an aerial geochemical method for exploring for ores of nickel, copper, lead, zinc, silver, and cobalt. The patented method used a device for concentrating airborne particulates from a large volume of air at known localities onto a tape. The particulate matter is later analyzed by spectrophotometry or wet-chemical techniques.

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[8] Industrial Research. High-Strength Nickel-Based Alloy WAZ–16. V. 16, No. 10, October 1974, p. 58.

[9] Industrial Research. Process for Fabricating Silicon Carbide (Carborosil Silicon Carbide). V. 16, No. 10, October 1974, p. 37.

[10] Riger, R. Nickel-Based Catalyst Used In Questor Reverter System. Am. Metal Market, v. 81, No. 201, October 1974, p. 5.

[11] Nordberg, D. Developments of Alloys, Steels Near Commercial Stages at INCO. Am. Metal Market, v. 81, No. 200, Oct. 14, 1974, p. 27.

[12] Barringer, A. R. (assigned to Barringer Research Ltd.). High Resolution Geochemical Prospecting Method. Can. Pat. 944,667, Apr. 2, 1974.

Nitrogen

By William F. Keyes [1]

Production of fixed and elemental (gaseous) nitrogen individually increased 4% over the production in 1973. Exports of fixed nitrogen declined 34%, and imports increased 21%, with the result that the United States was a net importer of this commodity in 1974 for the first time since 1965. Domestic consumption, including 160,000 tons of net imports, rose 3% to just short of 13.0 million tons of fixed nitrogen. Domestic consumption of elemental nitrogen was considered equal to production, as there are no significant stocks, exports, or imports.

One major domestic ammonia plant came onstream in 1974, and plans to construct five others were announced; additional capacity for this basic fixed nitrogen compound was completed at other plants. Total U.S. capacity for the production of anhydrous ammonia was estimated at 17,738,000 tons at yearend 1974.

Table 1.—Salient nitrogen statistics
(Thousand short tons of contained nitrogen)

	1970	1971	1972	1973	1974 [p]
United States:					
Production as ammonia	11,531	12,107	12,651	12,546	13,016
Production as nitrogen gas [1]	5,477	6,087	7,011	8,263	8,575
Exports of nitrogen compounds [2]	1,400	999	1,310	1,506	994
Imports for consumption of nitrogen compounds [2]	942	907	947	951	1,154
Consumption [3]	10,891	11,903	12,333	12,597	12,971
World: Production [2]	42,747	45,357	47,398	[r] 48,500	49,500

[p] Preliminary.

[1] Converted from reported volume (at 70° F and 1 atmosphere pressure) at 27,605 cubic feet per short ton.

[2] Estimated, excludes nitrogen gas.

[3] Includes producers' stock changes in synthetic anhydrous ammonia and coke oven ammonium compounds; excludes nitrogen gas.

DOMESTIC PRODUCTION

Domestic production of fixed nitrogen, as anhydrous ammonia, increased 4% in 1974, reaching 13.0 million tons. Elemental nitrogen production also increased 4%, to 8.6 million tons.

The Fertilizer Institute estimated that almost twice as much ammonia production, or about 340,000 tons, would be lost through curtailment of natural gas supplies in fiscal year 1974-75 as in the preceding year, when curtailments caused a loss of 185,000 to 190,000 tons of ammonia production.[2]

In response to S. Res. 289 of the U.S. Senate, the Federal Power Commission solicited comments from interested persons as to establishing priorities for allocation of natural gas to the fertilizer industry. After consideration, the Commission found that existing procedures were adequate to protect the interests of the fertilizer industries and agriculture-related activities.[3] The Commission further stated that it would continue to entertain petitions for extraordinary relief from curtailment from all natural gas consumers of standing, including fertilizer industries and agriculture-related activities, and grant such relief as might be warranted from the record.

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[1] Physical scientist, Division of Nonmetallic Minerals.

[2] Chemical Week. V. 115, No. 23, Dec. 4, 1974, p. 13.

Table 2.—Nitrogen production in the United States

(Thousand short tons of contained nitrogen)

	1970	1971	1972	1973	1974 p
Anhydrous ammonia: Synthetic plants [1]	11,384	11,972	12,512	12,413	12,894
Ammonia compounds, coking plants:					
Ammonia liquor	12	12	11	6	6
Ammonium sulfate	126	114	128	127	116
Ammonium phosphates	9	9	([2])	([2])	([2])
Total	11,531	12,107	12,651	12,546	13,016
Nitrogen gas [1]	5,477	6,087	7,011	8,263	8,575

p Preliminary.

[1] Bureau of the Census Current Industrial Reports.

[2] Included with ammonium sulfate to avoid disclosing individual company data.

Table 3.—Major nitrogen compounds produced in the United States

(Thousand short tons, gross weight)

Compound	1973	1974 p
Acrylonitrile	677	700
Ammonium nitrate	7,157	7,551
Ammonium sulfate [1]	2,181	2,065
Ammonium phosphates	6,771	6,829
Nitric acid	8,441	8,186
Urea	3,543	3,687

p Preliminary.

[1] Includes ammonium sulfate from coking plants.

Sources: Bureau of the Census and U.S. International Trade Commission.

Eighty-nine ammonia plants were operated in the United States during 1974, according to the Tennessee Valley Authority. A list of these plants is given in table 4. One major plant was brought onstream at Enid, Okla., in July by Farmland Industries, Inc.; it had a rated capacity of 1,000 tons per day but attained an output of nearly 1,200 tons per day.[4]

Announced during the year were plans to build five major new ammonia plants, with a total capacity of 6,250 tons per day. W. R. Grace & Co. planned to build a 1,200-ton-per-day plant near Woodward, Okla., at an estimated cost of $70 million.[5] Columbia Nitrogen Corp., Augusta, Ga., a subsidiary of the Dutch firm DSM, was to build a 1,500-ton-per-day plant near its older plant at Augusta.[6] International Minerals & Chemical Corp., with Commercial Solvents Corp., announced plans to build a 1,150-ton-per-day ammonia plant at Sterlington, La., at a cost of $55 million.[7] Agrico Chemical Co. and Farmland Industries, Inc., planned to build a plant with a capacity of 1,250 tons per day at Enid, Okla., adjacent to the recently inaugurated Farmland Industries plant.[8] First Mississippi Corp. also was scheduled to build a 1,150-ton-per-day ammonia plant at Donaldsonville, La.[9] In all, some 12 major ammonia plants were scheduled for completion between 1975 and 1979, including plants announced or started before 1974.

One smaller plant, owned by Agricultural Products Corp. (Beker Industries Inc.) at Soda Springs (Conda), Idaho, was scheduled to enter production at a rate of 300 tons per day in 1974-75, and a 200-ton-per-day plant was also announced, to be built by Tipperary Corp. near Lovington, N. Mex., in addition to Tipperary's smaller plant at the same site, which came onstream in 1974.[10]

The growth in elemental nitrogen production, 4% from 1973 to 1974, was the lowest since a decline was registered in 1968. Growth rates between 10% and 18% were characteristic of the early

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[3] Federal Register. Priority of Natural Gas Deliveries to Fertilizer Industry. V. 39, No. 141, July 22, 1974, pp. 26664-26668.

[4] Chemical Engineering. V. 81, No. 20, Sept. 30, 1974, p. 156.

[5] Chemical Marketing Reporter. Ammonia Plant to be Built of Grace. V. 205, No. 23, June 10, 1974, p. 3.

[6] Chemical & Engineering News. Columbia Nitrogen Set to Lift Ammonia Output. V. 52, No. 30, July 29, 1974, p. 6.

[7] Work cited in footnote 6.

[8] Fertilizer Progress. V. 5, No. 6, November-December 1974, p. 54.

[9] Chemical Week. V. 115, No. 20, Nov. 13, 1974, p. 9.

[10] Fertilizer International. New U.S. Ammonia Plants. No. 64, October 1974, p. 5.

1970's. The Bureau of the Census reported that 226 plants in 37 States produced elemental nitrogen in 1973.[11]

Table 4.—Domestic producers of anhydrous ammonia

(Thousand short tons per year of ammonia)

Company	Location	Capacity
Agrico Chemical Co.—Williams	Donaldsonville, La	400
Do	Blytheville, Ark	390
Agway, Inc	Olean, N.Y	85
Air Products and Chemicals, Inc	New Orleans, La	210
Do	Pace Jct., Fla	100
Allied Chemical Corp	Geismar, La	340
Do	Hopewell, Va	340
Do	LaPlatte, Nebr	200
Do	South Point, Ohio	160
American Cyanamid Co	Fortier, La	340
Amoco Chemicals Corp	Texas City, Tex	720
Apache Powder Co	Benson, Ariz	15
Atlas Chemical, Inc	Joplin, Mo	136
Beker Industries Inc	Conda, Idaho	100
Borden Chemical Div	Geismar, La	340
Camex, Inc	Borger, Tex	400
CF Industries, Inc	Fremont, Nebr	48
Do	Donaldsonville, La	750
Do	Terre Haute, Ind	135
Cherokee Nitrogen, Inc	Pryor, Okla	55
Chevron Chemical Co	Richmond, Calif	130
Do	Fort Madison, Iowa	105
Do	Pascagoula, Miss	510
Do	El Segundo, Calif	20
Collier Carbon & Chemical Corp	Kenai, Alaska	510
Do	Brea, Calif	260
Columbia Nitrogen Corp	Augusta, Ga	122
Commercial Solvents Corp	Sterlington, La	340
Diamond Shamrock Co	Dumas, Tex	160
Dow Chemical Co	Freeport, Tex	115
E. I. du Pont de Nemours & Co	Beaumont, Tex	340
Do	Belle, W. Va	340
Do	Victoria, Tex	100
Duval Corp	Hanford, Calif	21
El Paso Products Co	Odessa, Tex	115
Farmers Chemical Association—CF Industries, Inc	Tunis, N.C	210
Do	Tyner, Tenn	170
Farmers National Chemical Co	Plainview, Tex	60
Farmland Industries, Inc	Dodge City, Kans	210
Do	Fort Dodge, Iowa	210
Do	Hastings, Nebr	140
Do	Lawrence, Kans	340
Do	Enid, Okla	425
First Mississippi Corp	Fort Madison, Iowa	340
FMC Corp	South Charleston, W. Va	24
Gardinier, Inc	Tampa, Fla	120
Do	Helena, Ark	210
Goodpasture, Inc	Dimmitt, Tex	30
W. R. Grace & Co	Woodstock, Tenn	340
Do	Big Spring, Tex	100
Green Valley Chemical Co	Creston, Iowa	35
Hawkeye Chemical Co	Clinton, Iowa	138
Hercules, Inc	Hercules, Calif	70
Do	Louisiana, Mo	70
Hooker Chemical & Plastic Co	Tacoma, Wash	23
Kaiser Agricultural Chemicals	Savannah, Ga	150
Mississippi Chemical Corp	Pascagoula, Miss	175
Do	Yazoo City, Miss	340
Mobil Chemical Co	Beaumont, Tex	300
Monsanto Co	Luling, La	450
New Jersey Zinc Co	Palmerton, Pa	35
Nipak, Inc	Pryor, Okla	105
Do	Kerens, Tex	125
Occidental Agricultural Chemical Co	Lathrop, Calif	120
Do	Plainview, Tex	56
Olin Corp	Lake Charles, La	490
Pennsalt Chemical Co	Portland, Oreg	8
Phillips Pacific Chemical Co	Kennewick, Wash	155
Phillips Chemical Co	Beatrice, Nebr	210
Do	Pasadena, Tex	230
PPG Industries, Inc	Natrium, W. Va	50
Reichhold Chemicals, Inc	St. Helens, Oreg	90
Rohm and Haas Co	Deer Park, Tex	35
St. Paul Ammonia Products, Inc	East Dubuque, Ill	230

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[11] U.S. Department of Commerce, Bureau of the Census. Current Industrial Reports, Industrial Gases 1973. Series: M28C (73) 14, August 1974, 10 pp.

Table 4.—Domestic producers of anhydrous ammonia—Continued

(Thousand short tons per year of ammonia)

Company	Location	Capacity
J. R. Simplot Co	Pocatello, Idaho	108
Tenneco Chemical Co	Houston, Tex	210
Tennessee Valley Authority	Muscle Shoals, Ala	74
Terra Chemicals International, Inc	Port Neal, Iowa	210
Tipperary Corp	Lovington, N. Mex	34
Triad Chemical Co	Donaldsonville, La	340
USS Agri-Chemicals, Inc	Cherokee, Ala	177
Do	Clairton, Pa	325
Do	Geneva, Utah	70
Valley Nitrogen Producers, Inc	El Centro, Calif	210
Do	Helm, Calif	176
Do	Chandler, Ariz	33
Vistron Corp	Lima, Ohio	510
Vulcan Materials Co	Wichita, Kans	23
Wycon Chemical Co	Cheyenne, Wyo	167
Total		17,738

Source: North American Production Capacity Data, January 1975 (supplement to Fertilizer Trends 1973). Circular Z-57, National Fertilizer Development Center, Tennessee Valley Authority, Muscle Shoals, Ala., 11 pp.

CONSUMPTION AND USES

Apparent consumption of contained nitrogen was 13.0 million short tons in 1974. This was calculated, on the basis of preliminary figures, from production, stocks, exports, and imports of ammonia and coke oven compounds and the estimated nitrogen content of exports and imports of nitrogenous materials. This consumption was 3% higher than that in 1973.

It was estimated that 74% of the ammonia used in the United States in 1974 went into fertilizers, 8% into fibers and plastics, 4% into explosives, 3% into animal feeds, and 7% into other uses; losses were estimated at 4%.[12]

Elemental nitrogen had two principal uses: To exclude or purge air from industrial processes, including steelmaking, electronics, chemical manufacture, glassmaking, and others, and as a liquid, to provide low temperatures, through evaporation, in food, shipping, scientific applications, and other processes. These latter cryogenic applications, which are estimated at 18% of total use, were considered to have good growth potential.

PRICES

Prices of all nitrogen compounds approximately doubled during the year. The energy crisis, heavy demand in agriculture, the difficulty of rapidly increasing capacity, and the uncertainty caused by widely varying estimates of future demand all tended to push up prices. Severe inflation in capital and operating costs made it unlikely that prices would, in the future, descend to earlier levels.

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[12] Chemical & Engineering News. Ammonia Squeeze Loosens, Outlook Stays Good. V. 53, No. 17, Apr. 28, 1975, pp. 10–13.

Table 5.—Price quotations for major nitrogen compounds in 1974

(Per short ton)

Compound	Jan. 1	Dec. 31
Ammonium nitrate, domestic, fertilizer-grade, 33.5% nitrogen, bulk, delivered	$47-$78	$91-$115
Ammonium sulfate, standard-grade, commercial, bulk, f.o.b. works	15-25	89
Anhydrous ammonia, fertilizer, wholesale, tanks, delivered east of Rockies, except East Coast	60-110	190-210
Aqueous ammonia, 29.4% NH_3, anhydrous basis, tanks, freight equalized east of Rockies	76-79	165-180
Delivered east coast	60-65	--
Sodium nitrate, domestic, agricultural, bulk, carlots, f.o.b. works	51.50	127
Bags, carlots, f.o.b. works	55.50	138
Sodium nitrate, imported, commercial, bulk, carlots, f.o.b. Atlantic and Gulf warehouses	51.50	132
100-pound bags, carlot, same basis	55.50	143
Urea:		
Industrial, 46% nitrogen, bulk, 50-ton carlots, delivered East	75-107	160-175
Agricultural, 46% nitrogen, bulk, same basis	73-107	160-175
Agricultural, 45% nitrogen, bulk, 50-ton carlots, delivered East	72-104	160-175
Diammonium phosphate, fertilizer grade, 18-46-0, bulk, carlots, f.o.b. Florida works	75-110	145-165

Source: Chemical Marketing Reporter.

FOREIGN TRADE

Exports of contained nitrogen declined from 1,506,000 tons in 1973 to 994,000 tons in 1974. At the same time, imports rose from 951,000 to 1,154,000 tons. The U.S. nitrogen deficit of 160,000 tons in 1974 was the first since 1965. Almost all categories of products showed the same pattern of increased imports and decreased exports, but the pattern was particularly pronounced for anhydrous ammonia.

Table 6.—U.S. exports and imports for consumption of major nitrogen compounds

(Thousand short tons and thousand dollars)

Compounds	1973			1974		
	Gross weight	Nitrogen content	Value	Gross weight	Nitrogen content	Value
EXPORTS						
Industrial chemicals: Anhydrous ammonia and chemical-grade aqua (ammonia content)	186	153	9,185	66	54	6,755
Fertilizer materials:						
Ammonium nitrate	41	14	3,670	18	6	2,334
Ammonium phosphates	2,235	402	189,065	1,992	359	358,807
Ammonium sulfate	528	109	15,378	530	109	35,952
Anhydrous ammonia and aqua (ammonia content)	[r] 718	588	[r] 31,200	326	267	41,220
Nitrogenous chemical materials n.e.c	28	8	1,896	27	8	3,473
Sodium nitrate	1	(1)	59	2	(1)	223
Urea	427	194	33,054	316	144	63,409
Mixed chemical fertilizers	375	38	34,084	474	47	53,476
Total	[r] 4,539	1,506	[r] 317,591	3,751	994	565,649
IMPORTS						
Industrial chemicals: Ammonium nitrate	4	2	270	8	3	923
Fertilizer materials:						
Ammonium nitrate	338	112	15,367	369	124	25,124
Ammonium nitrate-limestone mixtures	10	2	393	333	70	36,129
Ammonium phosphates	393	51	27,290	344	62	40,509
Ammonium sulfate	299	62	10,610	258	53	20,232
Calcium cyanamide or lime nitrogen	4	1	462	3	(1)	503
Calcium nitrate	156	24	5,064	155	24	7,896
Nitrogen solutions	193	58	7,380	87	26	7,193
Anhydrous ammonia	[r] 330	[r] 271	[r] 16,198	455	373	52,205
Potassium nitrate or saltpeter, crude	[r] 30	[r] 4	[r] 2,334	14	2	1,797
Potassium nitrate, sodium nitrate mixtures	53	8	2,737	27	4	2,503
Sodium nitrate	[r] 74	[r] 12	[r] 3,069	150	24	14,356
Urea	674	[r] 307	38,865	717	326	87,870
Nitrogenous fertilizers n.s.p.f	91	18	[r] 4,986	168	34	14,387
Mixed chemical fertilizers	193	19	11,642	286	29	33,603
Total	[r] 2,842	[r] 951	[r] 146,667	3,374	1,154	345,230

[r] Revised.

[1] Less than ½ unit.

WORLD REVIEW

It was estimated that worldwide, 126 ammonia plants were announced for construction in the period 1974–80, with an average size of over 1,000 tons per day; this would increase capacity 41% in the period, or 6% per year.[13] As the year progressed, additional plans for construction of ammonia and urea plants were announced. It was uncertain how many of the plants in either category would actually be constructed.

Argentina.—On August 24, representatives of Bolivia and Argentina signed a 16-point Act of Cooperation and Complementation, largely concerned with production of goods from raw materials. One point calls for the construction close to the mutual border of a binational fertilizer plant to produce 1,100 short tons per year each of ammonia and urea.[14]

Bulgaria.—Another ammonia-urea complex will be added to either the Varna or Vratsa fertilizer works to produce about 1,100 short tons per day of ammonia and 2,200 tons per day of urea.[15]

Canada.—Numerous proposals for new petrochemical plants, including ammonia plants, were presented to the Alberta Provincial Government during 1974. Regulations had been amended by the Government to require an industrial permit from the Energy Resources Conservation Board for new plants planning to use natural gas. Emphasis was thus shifting from marketing of resources to conservation.

Three fertilizer projects initiated by companies already operating in Alberta were approved by the Alberta Government and exempted from the permit requirement: (1)Cominco Ltd., for a 400,000-ton-per-year anhydrous ammonia and 480,000-ton-per-year urea plant at Carseland; (2)Western Cooperative Fertilizers Ltd. for 1,200 and 1,500 tons per day of ammonia and urea, respectively, at Medicine Hat; and (3)Sherritt Gordon Mines, for expansion to 1,500 and 1,200 tons per day of ammonia and urea, respectively, at Fort Saskatchewan.[16]

The Deputy Premier of Saskatchewan stated in August that one of the requirements for new ammonia plants was a stepped-up involvement in exploring for and developing new gasfields. Of the 30 proposals for ammonia plants presented in 1973 and 1974, he believed a maximum of 8 plants would result.

Chile.—Sociedad Química y Minera de Chile (SOQUIMICH), Chile's State-owned nitrate corporation, began plans in 1974 for a $35 million expansion program in view of the rise in world nitrate prices brought on by petroleum price increases. Production is expected to rise from 815,000 short tons of all nitrates in 1974 to 935,000 tons in 1975 and 1,045,000 tons in 1976.[17]

Colombia.—Tentative plans for two ammonia plants, each of 100,000-ton-per-year capacity, near the Guajira gasfield were under study; the project would be a joint venture of Texaco and the Empresa Colombiana de Petróleos (ECOPETROL).[18]

Ecuador.—An ammonia-urea plant is high on the list of Government priorities. A minimum production of 66,000 short tons of ammonia is contemplated, based on natural gas deposits in the Gulf of Guayaquil. The plant would most likely be located in the Puerto Bolivar-Machala area.[19]

Egypt.—A protocol signed by Egypt and Iran called for the financing by Iran of a 330,000-ton-per-year ammonia plant in Egypt based on local natural gas. The plant is part of a $1 billion economic cooperation agreement between the two countries.[20]

Germany, East.—A 1,500-ton-per-day, U.S.-designed ammonia plant was brought into production in Piesteritz. A second 1,500-ton plant was under construction at the same location under a contract let by VEB Industrieanlagen Import, an agency of the East German Government.[21]

India.—At the end of 1974 around 15 fertilizer plants were under construction in India, but completion of nearly all had been delayed. Most of these included both ammonia and urea plants. Total output of final product, largely urea, is estimated to be 4.6 million tons when the last plant is commissioned about 1978. The plants will use naphtha, natural gas, coal, and fuel oil as feedstocks.[22]

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[13] Roher, W. M. Annual Meeting, International Superphosphate Manufacturers Association, Tenerife, Canary Islands, May 14, 1974.

[14] U.S. Embassy, La Paz, Bolivia. Airgram A-187, Oct. 7, 1974, p. 3.

[15] European Chemical News. Bulgaria Plans New Ammonia-urea Complex. V. 26, No. 663, Nov. 22, 1974, p. 14.

[16] U.S. Consulate, Calgary, Canada. Airgram A-112, Nov. 14, 1974, 4 pp.

[17] U.S. Embassy, Santiago, Chile. Airgram A-107, June 25, 1975, p. 2.

[18] U.S. Embassy, Bogota, Colombia. Airgram A-211, Dec. 6, 1974, p. 2.

[19] U.S. Embassy, Quito, Ecuador. Telegram 2868, Apr. 30, 1974, 2 pp.

[20] European Chemical News. Iran/Egypt Pact Includes Fertilizer Units. V. 25, No. 638, May 31, 1974, p. 16.

[21] Chemical Marketing Reporter. Kellogg Ammonia Plant Running in E. Germany. V. 205, No. 17, May 16, 1974, p. 4.

Indonesia.—A team from the Tennessee Valley Authority completed a report on the potential for the nitrogen fertilizer industry in Indonesia. The report contained hard data confirming a preliminary assessment of Indonesian export potential; Indonesia would have a cost advantage over other possible exporters in supplying ammonia and urea to markets between the east coast of India and the southern half of the People's Republic of China. The Indonesian Government intended to price natural gas from fields too small for liquefied natural gas production but not too small for ammonia, at 50 to 60 U.S. cents per 1,000 cubic feet. There are reportedly a sufficient number of such fields to support any contemplated ammonia production.[23]

Planning continued for the construction in Europe of a 1,650-ton-per-day ammonia plant and a 1,870-ton-per-day urea plant on board two ships, which would then be moored near gasfields off Kalimantan, Borneo.[24] Indonesia's State-owned petrochemical company, P.T. Pupuk Sriwidjaja (PUSRI), also let contracts for the design and construction of a 1,100-ton-per-day ammonia plant and a 1,900-ton-per-day urea plant on the Musi River in Southern Sumatra.[25]

Iran.—A plant to produce 1,320 short tons per day of ammonia was planned as part of the expansion of the Iran Fertilizer Co. at Shiraz. A capacity for 1,650 tons per day of urea and additional facilities for nitric acid and ammonium nitrate were to be included.[26]

Italy.—A new 1,650-ton-per-day ammonia plant, with adjacent urea facilities, will be added to Montedison's complex at Ferrara. Feedstock will be local natural gas, and completion is scheduled for late 1976.[27]

Korea, Republic of.—A $200 to $300 million grassroots fertilizer complex was to be built at Yosu. It will be operated by Namhae Chemical Co. The associated 2,000-short-ton-per-day ammonia plant will be designed by the M. W. Kellogg Co. of Houston Texas, and a urea plant at the site will be designed and constructed by Toyo Engineering of Japan. Startup of the complex is expected in 1977–78.[28]

Mexico.—A 1,000-ton-per-day ammonia plant was brought onstream by Petróleos Mexicanos at Cosoleacaque. Contracts for three additional plants were awarded to the M. W. Kellogg Co.; two of them, also to be located at Cosoleacaque, were of 1,500-ton-per-day capacity, and the third, at Salamanca, was to have a capacity of 1,000 tons per day.[29] The new units were to increase Mexico's ammonia capacity to 6,900 short tons per day by 1977.

Romania.—An ammonia and a urea plant, each with a capacity between 1,000 and 1,500 tons per day, were included in a grassroots fertilizer complex to be erected at Tecuci.[30]

Trinidad and Tobago.—The Prime Minister stated that a 2,000-ton-per-day ammonia plant would be constructed under an arrangement with Amoco; a 1,800-ton urea plant is also to be built in conjunction with the ammonia plant. Also in the consideration stage were proposals for two additional ammonia plants.[31]

United Kingdom.—A decision was reached to construct the Scanitro ammonia plant near Peterhead, Scotland, but the planned size of the plant was reduced to 300,000 to 350,000 tons per year. The project is an equally owned joint venture of Norsk Hydro and Supra UK, a subsidiary of the Swedish firm, Supra AB. The bulk of the output will be exported.[32]

U.S.S.R.—A contract for four ammonia plants, with a capacity of 1,500 short tons each, was awarded by Techmashimport to the French firm Creusot-Loire Entreprises.

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[22] Nitrogen (London). No. 92, November-December 1974, p. 16.

[23] U.S. Embassy, Jakarta, Indonesia. Telegram 5110, Apr. 27, 1974, 3 pp.

[24] Chemical Engineering. Plans Underway for Floating NH_3 and Urea Plants. V. 81. No. 24, Nov. 11, 1974, p. 77.

[25] Chemical Marketing Reporter. Urea, Ammonia Plant Contracts Are Let by Indonesia's State-owned Corporation. V. 206, No. 8, Aug. 19, 1974, p. 7.

[26] American Embassy, Beirut, Lebanon. Airgram A–29, Feb. 11, 1974, 10 pp. w/enclosure.

[27] Fertilizer International. More Ammonia for Montedison. No. 60, June 1974, p. 1.

[28] European Chemical News. U.S. Contractors Win S. Korean Fertilizer Orders. V. 25, No. 646, July 26, 1974, p. 16.

[29] Fertilizer International. Big Contracts to Kellogg—in Mexico. No. 61, July 1974, p. 1.

[30] Work cited in footnote 20.

[31] U.S. Embassy Port of Spain, Trinidad and Tobago. Telegram 2343, Sept. 27, 1974, 3 pp.

[32] European Chemical News. Scanitro Ammonia Project Goes Ahead—Halved in Size. V. 26, No. 663, Nov. 22, 1974, p. 11.

Two will probably be near Goglovka in the Ukraine, and the others, at Kemerovo, near Novosibirsk, in Siberia. The plants were originally scheduled to be located at Togliatti, near the plants to be built by Chemical Construction Corp. of the United States under the Occidental Petroleum Corp. barter arrangements, but plants at Togliatti, near Kuibyshev, will be limited to the four by Chemical Construction.[33] The four Creusot-Loire plants will use M. W. Kellogg Co. technology. Two other Kellogg-designed plants, with a capacity of 1,500 tons a day each, went onstream in April and December at Severodovetsk, and Kellogg-designed plants in the U.S.S.R. are now reported to total nine.[34]

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[33] Chemical Engineering. V. 81, No. 17. Aug. 19, 1974, p. 38.

[34] Chemical Engineering News. V. 52, No. 32, Aug. 12, 1974, p. 6.

Table 7.—Fertilizer nitrogen compounds: World production and consumption for years ended June 30, by country

(Thousand short tons of contained nitrogen)

Country	Production 1971–72	Production 1972–73	Production 1973–74 [p]	Consumption 1971–72	Consumption 1972–73	Consumption 1973–74 [p]
North America:						
Canada	887	882	906	386	495	584
Costa Rica	19	18	30	[e][1] 30	[e][1] 29	[e][1] 37
Cuba	6	2	33	[1] 135	[1] 114	148
Dominican Republic	--	--	--	29	46	46
El Salvador [e]	8	2	8	69	72	75
Guatemala	--	--	--	15	26	35
Mexico	361	393	414	572	519	586
Netherlands Antilles [e]	13	20	7	--	--	--
Trinidad and Tobago [e][2]	104	126	74	7	8	8
United States (includes Puerto Rico)	8,919	9,296	10,088	8,016	8,295	9,124
South America:						
Argentina	44	[e] 42	[e] 42	[e] 50	[e] 54	[e] 56
Brazil [1]	75	87	182	307	454	446
Chile [1]	[e] 140	[e] 119	[e] 118	53	58	65
Colombia [1]	76	85	95	86	125	170
Ecuador [e]	--	2	2	9	22	32
Peru [3]	27	25	23	79	110	89
Venezuela [1]	6	11	5	37	40	45
Europe:						
Albania [e][1]	40	40	40	34	36	40
Austria	255	253	255	154	150	146
Belgium	672	704	719	184	184	182
Bulgaria [1]	620	577	572	355	390	362
Czechoslovakia	[e][1] 404	[e][1] 451	[e][1] 468	480	[e] 516	494
Denmark [4]	83	85	92	340	363	402
Finland	221	268	265	201	198	228
France	1,562	1,622	1,867	1,681	1,832	2,021
Germany, East [1]	428	472	453	636	725	734
Germany, West	1,456	1,621	1,624	1,247	1,311	1,213
Greece	214	[e] 243	281	227	[e] 231	255
Hungary [1]	416	412	468	434	465	543
Iceland [1]	8	9	11	15	15	15
Ireland	[e] 96	[e] 93	[e] 104	108	145	144
Italy	1,140	1,152	1,238	689	763	741
Luxembourg	[e] 2	[e] 2	[e] 2	13	[e] 14	15
Netherlands	1,144	1,310	1,392	412	414	453
Norway	423	436	490	90	87	94
Poland	[1] 1,191	[1] 1,265	[1] 1,505	1,000	1,079	1,179
Portugal	135	[e] 165	181	100	[e] 144	157
Romania [1]	911	963	941	475	464	463
Spain [1]	658	758	830	684	735	752
Sweden [5]	195	187	197	258	257	290
Switzerland	27	29	27	41	43	46
U.S.S.R.[1]	6,674	7,221	7,982	5,712	6,199	6,896
United Kingdom [5]	851	828	1,085	1,025	870	1,080
Yugoslavia [1]	280	294	297	367	375	374
Africa:						
Algeria [e]	43	55	57	75	94	103
Egypt, Arab Republic of	[e][1] 132	[e][1] 167	[e][1] 86	[e] 358	[e] 398	[e] 364
Ivory Coast [e][1]	2	8	6	6	10	7
Kenya	--	--	--	[e] 20	20	22
Morocco [1]	22	13	13	53	72	74
Mozambique	2	[e] 10	9	7	[e] 8	10
Rhodesia, Southern [e]	67	64	66	78	66	77
Senegal	8	10	10	6	6	8

See footnotes at end of table.

Table 7.—Fertilizer nitrogen compounds: World production and consumption for years ended June 30, by country—Continued

(Thousand short tons of contained nitrogen)

Country	Production			Consumption		
	1971–72	1972–73	1973–74 [p]	1971–72	1972–73	1973–74 [p]
Africa—Continued						
South Africa, Republic of [e,1]	246	273	272	230	279	255
Sudan [e]	--	--	--	50	97	77
Tanzania [1]	--	[e] 2	[e] 2	[e] 12	9	12
Tunisia [e]	--	--	--	20	17	21
Zambia	10	[e] 8	5	36	[e] 28	26
Asia:						
Bangladesh	23	102	142	86	143	134
Burma	36	41	51	30	35	46
China, People's Republic of [e,1,7]	1,820	2,240	2,760	3,445	3,620	3,640
India	1,043	1,162	1,157	1,940	1,960	2,023
Indonesia	53	66	100	216	383	386
Iran	[e] 95	157	157	118	136	195
Iraq	[e] 12	29	31	15	[e] 17	28
Israel	26	26	35	36	37	38
Japan	2,348	2,705	2,429	743	808	989
Korea, North [e,1]	243	254	265	239	248	265
Korea, Republic of	[e,1] 496	[1] 461	[1] 493	[e] 383	411	453
Kuwait	203	297	319	--	--	--
Lebanon [e]	[1] 8	[1] 3	NA	32	36	43
Malaysia	[e] 47	[e] 44	[e] 51	73	89	112
Pakistan	237	302	332	400	426	496
Philippines [e]	[1] 65	[1] 61	[1] 58	134	126	161
Saudi Arabia	88	76	99	[e] 2	[e] 2	[e] 4
Sri Lanka	--	--	--	49	60	56
Syrian Arab Republic	4	17	10	35	36	37
Taiwan [8]	209	209	214	194	176	193
Thailand	[1] 11	[1] 8	[1] 9	[e] 68	[e] 68	[e] 77
Turkey [1]	[e] 81	161	169	316	412	463
Vietnam, North [e,1]	--	--	--	34	12	16
Vietnam, South [e,1]	--	--	--	108	165	121
Oceania: Australia [e]	194	201	217	132	182	194
Other:						
North and Central America [9]	--	--	--	79	82	100
South America [10]	--	--	--	36	37	31
Europe [11]	--	--	--	2	2	2
Africa [12]	--	--	--	124	114	112
Asia [13]	--	--	--	46	61	61
Oceania [14]	--	--	--	20	45	47
World total	38,610	41,802	45,037	36,928	39,505	42,439

[e] Estimate. [p] Preliminary. NA Not available.

[1] Calendar year referring to the first part of the split year.

[2] Excludes nitrogen content of anhydrous ammonia produced for export in that form for subsequent processing elsewhere.

[3] Production of guano only.

[4] Fertilizer year: August-July.

[5] Fertilizer year: June-May.

[6] Fertilizer year: November-October.

[7] United States Bureau of Mines estimate based on United Nations estimate for the People's Republic of China and Taiwan (reported as a single figure) less the British Sulphur Corp. Ltd. reported figure for Taiwan alone.

[8] Source: The British Sulphur Corporation Ltd. Statistical Supplement No. 10, November-December 1974, London 1974, pp. 14–15.

[9] Includes Barbados, Belize, Guadeloupe, Haiti, Honduras, Jamaica, Martinique, Nicaragua, Panama, St. Kitts, Nevis and Anguilla, St. Lucia, and St. Vincent.

[10] Includes Bolivia, Guyana, Paraguay, Surinam, and Uruguay.

[11] Includes Channel Islands and Isle of Man.

[12] Includes Angola, Botswana, Cameroon, Central African Republic, Chad, Congo, Dahomey, Equatorial Guinea, Ethiopia, Gambia, Ghana, Guinea, Liberia, Libya, Malagasy Republic, Malawi, Mali, Mauritius, Niger, Nigeria, Reunion, Rwanda, Sierra Leone, Somalia, Swaziland, Togo, Uganda, Upper Volta, and Zaire.

[13] Includes Afghanistan, Burundi, Cyprus, Jordan, Khmer Republic, Laos, Mongolia, Nepal, and Singapore.

[14] Includes Fiji Islands, New Zealand, and Papua New Guinea.

Source: Statistical Office of the United Nations, Statistical Yearbook, 1974. New York, 1975, pp. 281–282, 549–551, unless otherwise specified.

TECHNOLOGY

A review of the technical and economic aspects of ammonia production in the light of sharp changes in the availability and price of feedstocks was published.[35] Some 75% to 80% of worldwide ammonia production is obtained via catalytic steam reforming of light hydrocarbons; approximately 60% to 65% of the catalytic steam reforming utilizes natural gas feed. These percentages will more or less be maintained in the near future, but prospects are that over the long range utilization of coal and heavy hydrocarbons will increase substantially. These feedstocks require the noncatalytic partial oxidation process and, especially for coal feedstock, must be based on high ammonia capacity to be competitive; that is, a capacity in the range of 1,000 to 1,500 tons of product per day or even more.

Floating ammonia plants, constructed on vessels to be moored near natural gasfields, are to be tested in a $150 million project (see World Review—Indonesia).

The turndown efficiency of a single-train ammonia plant was discussed; in periods of curtailment of natural gas supplies, turndown or changing temporarily to fuel oil are possible alternatives. Tests showed that process gas consumption remained constant per ton of product, but that efficiency of fuel gas use and overall plant efficiency declined sharply when the plant rate decreased from 90% to 70% capacity. The alternative use of fuel oil to maintain plant output was as efficient as use of natural gas but presented problems of safety and complexity of operation.[36]

A survey of the causes of downtime in ammonia plants was published. Some 27 plants, representing 75% of the large tonnage plants in North America, participated. Major equipment failures were paramount among plants surveyed in 1971–72. Overall reliability of the plants had increased from earlier surveys. Other causes of downtime, such as instrument and electrical failures, were discussed, as well as important reasons for continued increase in reliability.[37]

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[35] Buividas, L. J., J. A. Finneran, and O. J. Quartulli. Alternate Ammonia Feedstocks. Chem. Eng. Prog., v. 70, No. 10, October 1974, pp. 21–35.

[36] Sawyer, J. G., and G. P. Williams. Turndown Efficiency of a Single Train Plant. Chem. Eng. Prog., v. 70, No. 2, February 1974, pp. 62–64.

[37] Williams, G. P., and J. G. Sawyer. What Causes Ammonia Plant Shutdown? Chem. Eng. Prog., v. 70, No. 2, February 1974, pp. 45–53.

Peat

By Donald P. Mickelsen [1]

Peat production in the United States increased 15% in 1974, principally because of greater output at several of the larger operations. The number of active operations increased by four, even though two operations were closed due to a lack of environmental permits. Production increased in 18 States; the largest production gains were recorded in Michigan, Illinois, Florida, Indiana, and Minnesota.

Commercial sales of peat in the United States were 14% higher than in 1973. The total value of peat sold, f.o.b. plant, rose 28% to $11.0 million. The average value of all peat sold in 1974 increased $3.40 per ton, principally due to higher fuel, production, and transportation costs.

Imports remained fairly constant in 1974, increasing less than 1%. Imported peat comprised 32% of the peat available for consumption in the United States, a drop of nearly 2% from 1973. Ninety-six percent of the peat imported came from Canada.

World production was estimated at 220.3 million short tons. The U.S.S.R. was the largest producer with an output estimated at 211 million tons, or 96% of the world total.

DOMESTIC PRODUCTION

The 97,000-ton increase in production resulted mainly from a larger output of reed-sedge-type peat. Of the reported production, more than 60% was reed-sedge peat; the remainder was about equally divided between moss peat and humus.

Peat was produced in 23 States in 1974. Michigan remained the largest producer, with about one-third of the Nation's output. Illinois, Florida, Indiana, Pennsylvania, and New Jersey ranked in output in the order named. Together with Michigan, these States accounted for three-fourths of the total production.

Active operations in the United States increased from 98 to 102, and the average output per plant increased 11% to 7,167 short tons. Almost three-fourths of the operations, however, had outputs smaller than the average. Only 32 plants had production in excess of 5,000 tons, and only 5 plants produced more than 25,000 tons.

Production methods in the United States vary with size and conditions of the operation. Virtually all peat was harvested using conventional earthmoving and excavating machinery, or conventional machinery with modifications. Machinery such as power shovels, bulldozers, and front-end loaders was used in drained bogs, while draglines, clamshells and dredges were used in submerged deposits.

Peat deposits, which are generally covered with water, tree trunks, limbs, and other debris, must be properly cleared and drained before harvesting can be started. In most instances, the bog is drained by constructing a series of feeder ditches and collecting canals so that the prevailing water table can be lowered and controlled. Since the surface of the bog is infirm, roads are built on it to provide a firm surface for trucks. Other machinery is equipped with special wide-track treads, enabling it to operate upon the bog surface.

A variety of harvesting methods are

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[1] Mineral specialist, Division of Coal.

employed at peat operations in the United States. Generally, the peat is harvested by first loosening the top layer of the bog to a depth of approximately one-half inch with a disk, spike, or spring harrow. The loosened peat is then scraped into piles alongside the roads with bulldozers and loaded into trucks with front-end loaders. Other production methods utilize vacuum harvesters, snowblowing machines, draglines, and dredges.

Peat is usually processed for sale by air drying, shredding, and screening, and in a few instances by artificial drying. Processing equipment consists of a variety of screens, shredders, grinders, hammermills, and gas- and oil-fired dryers.

Roughly one-third of the peat was sold as produced with no processing other than air drying. Sixty-eight percent was shredded, and only 1% was subjected to thermal drying.

Table 1.—Salient peat statistics

	1971	1972	1973	1974
United States:				
Number of operations	120	103	98	102
Production short tons	605,382	576,712	634,503	731,004
Commercial sales do	599,548	606,679	620,583	705,995
Value thousands	$7,011	$7,112	$7,547	$10,989
Average per ton	$11.69	$11.72	$12.16	$15.56
Imports short tons	296,283	310,521	323,501	326,530
Available for consumption[1] do	895,831	917,200	944,084	1,032,525
World: Production thousand short tons	[r] 221,248	[r] 221,143	220,172	220,344

[r] Revised.

[1] Commercial sales plus imports.

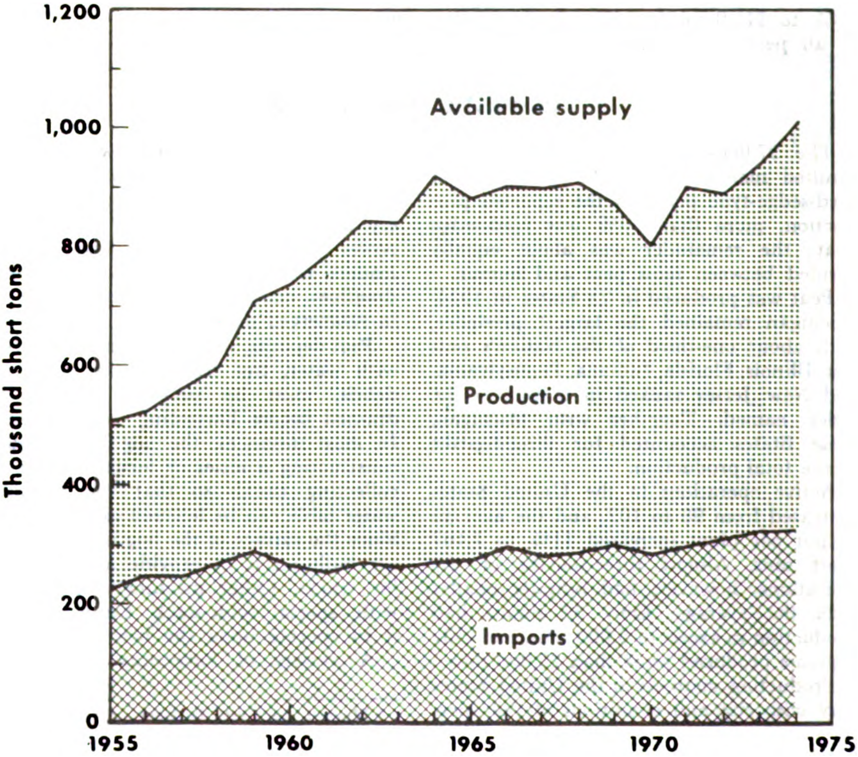

Figure 1.—Production, imports, and available supply of peat in the United States.

Table 2.—Peat produced in the United States in 1974, by kind
(Short tons)

Kind	Unprepared	Processed			Total
		Shredded	Kiln-dried only	Shredded and kiln-dried	
Moss	49,337	79,415	--	1,138	129,890
Reed-sedge	150,356	293,831	--	1,269	445,456
Humus	26,664	125,949	2,727	318	155,658
Total	226,357	499,195	2,727	2,725	731,004

Table 3.—Production and commercial sales of peat in the United States in 1974, by State

State	Active plants	Production (short tons)	Commercial sales		
			Quantity (short tons)	Value	
				Total (thousands)	Average per ton
California	8	14,447	14,447	$322	$22.28
Colorado	8	30,994	30,444	201	6.61
Florida	9	67,288	67,288	616	9.16
Georgia	2	550	550	6	10.73
Illinois	6	95,807	95,807	1,412	14.74
Indiana	9	63,846	71,194	946	13.29
Maine	3	4,562	3,585	194	54.24
Maryland	1	2,873	2,873	45	15.78
Massachusetts	1	2,600	2,600	85	32.69
Michigan	16	272,066	244,223	3,811	15.61
Minnesota	5	20,386	20,142	471	23.39
New Jersey	3	31,211	31,298	603	19.25
New Mexico	1	4,450	4,450	111	25.00
New York	4	16,208	17,603	181	10.26
North Dakota	1	240	240	W	W
Ohio	7	4,652	4,652	74	15.89
Pennsylvania	9	33,519	30,344	515	16.97
South Carolina	1	17,800	17,800	W	W
Vermont	1	143	143	4	29.37
Washington	5	14,492	14,492	85	5.84
Other States [1]	7	32,870	31,820	1,307	41.07
Total	102	731,004	705,995	10,989	15.56

W Withheld to avoid disclosing individual company confidential data; included with "Other States."

[1] Includes Iowa, Montana, Wisconsin and states indicated by symbol W.

Table 4.—Relative size of peat operations in the United States

Size	1973				1974			
	Active plants		Production		Active plants		Production	
	Number	Percent of total	Short tons	Percent of total	Number	Percent of total	Short tons	Percent of total
Under 500 tons	19	19.4	3,620	0.6	21	20.6	4,384	0.6
500 to 999 tons	11	11.2	7,798	1.2	9	8.8	6,035	0.8
1,000 to 4,999 tons	40	40.8	98,076	15.5	40	39.2	94,899	13.0
5,000 to 14,999 tons	15	15.3	123,368	19.4	22	21.6	201,206	27.5
15,000 to 24,999 tons	7	7.2	117,439	18.5	5	4.9	89,278	12.2
Over 25,000 tons	6	6.1	284,202	44.8	5	4.9	335,202	45.9
Total	98	100.0	634,503	100.0	102	100.0	731,004	100.0

CONSUMPTION AND USES

Although imports remained at practically the same level, commercial sales increased in 1974 and the amount of peat available for consumption was about 9% greater than in 1973.

Peat was used for a variety of purposes, but 90% of total commercial sales reported by producers were for general soil improvement. Among the principal markets for this peat were nurseries and greenhouses, which used peat as a mulch and a medium for growing plants and shrubs; landscape gardeners and contractors, who used peat for building lawns and golf course greens and for transplanting trees and shrubs; and garden, hardware, and variety stores, which sold peat to homeowners for mulching and improving lawn and garden soils. The remaining peat was sold principally for use in potting soils, for packing flowers and shrubs, and for mushroom beds. Small quantities were also used for earthworm culture, for seed inoculant, and in mixed fertilizers.

Fifty-four percent of the peat sold commercially by producers was packaged and accounted for more than two-thirds of the total value of sales. Package sizes varied greatly, but most producers used 40-pound bags, a change from the 50-pound bags previously used, in order to save on transportation costs. About two-thirds of the packaged peat sold was of the reed-sedge type, one-fifth was humus, and the remainder was moss peat.

States leading in sales of packaged peat were Michigan, Illinois, and Indiana. Together, these States reported 79% of the total sales of packaged peat. Michigan, the largest producer, had 49% of the total sales.

Of the bulk peat, 81% was reported sold for general soil improvement. The remainder of the bulk peat was sold for use in potting soil and for packing flowers and shrubs.

Table 5.—Commercial sales of peat in the United States in 1974, by kind and use

Use	Moss		Reed-sedge		Humus	
	Quantity (short tons)	Value (thousands)	Quantity (short tons)	Value (thousands)	Quantity (short tons)	Value (thousands)
Bulk:						
Soil improvement	73,404	$847	114,572	$1,354	76,957	$742
Other uses	32,854	301	12,898	132	16,087	147
Total[1]	106,258	1,148	127,470	1,486	93,044	888
Packaged:						
Soil improvement	19,452	674	293,571	5,043	58,626	1,208
Other uses	2,584	75	1,722	116	3,268	352
Total	22,036	749	295,293	5,159	61,894	1,560
Total:						
Soil improvement	92,856	1,521	408,143	6,397	135,583	1,950
Other uses[1]	35,438	376	14,620	247	19,355	498
Grand total[1]	128,294	1,897	422,763	6,644	154,938	2,448

[1] Data may not add to totals shown because of independent rounding.

Table 6.—Commercial sales of peat in the United States in 1974, by use

Use	In bulk		In packages		Total[1]	
	Quantity (short tons)	Value (thousands)	Quantity (short tons)	Value (thousands)	Quantity (short tons)	Value (thousands)
Soil improvement	264,933	$2,942	371,649	$6,925	636,582	$9.867
Seed inoculant	1,644	10	2,890	301	4,534	311
Packing flowers, shrubs, etc	14,411	133	808	21	15,219	155
Potting soils	29,988	299	3,374	165	33,362	464
Mushroom beds	12,055	90	--	--	12,055	90
Earthworm culture	3,341	37	40	(2)	3,381	38
Mixed fertilizers	400	10	--	--	400	10
Other	--	--	462	53	462	53
Total[1]	326,772	3,522	379,223	7,467	705,995	10,989

[1] Data may not add to totals shown because of independent rounding.

[2] Less than ½ unit.

PRICES AND SPECIFICATIONS

Prices of peat at individual operations varied greatly in 1974, with the price depending mainly upon the kind of peat sold, the amount of processing, and whether the peat was sold in bulk or packaged form.

The overall average value per ton, f.o.b. plant, for all peat sold in 1974 was $15.56, up from $12.16 in 1973. The bulk of the increase was attributed to higher average receipts for peat sold by producers in Iowa, New Jersey, Pennsylvania, and Michigan.

The average price of bulk peat increased $1.94 per ton to $10.78. Packaged prices increased an average of $5.12 per ton to $19.69. The average price of bulk peat was influenced mainly by higher overall prices for bulk sales by producers in California, South Carolina, Pennsylvania, and Iowa. The increase in the unit value of packaged peat was attributed to greater receipts for packaged peat sold by Michigan producers.

In a few instances, when producers did not report the value of the peat sold, the sales value was calculated, based upon the average of peat sold within the State.

Imported peat had a total value of $22.6 million. This value was 20% greater than in 1973, partially because there was 3,000 tons more peat imported, but also because the average value per ton increased from $58.00 to $69.16.

Although the average value of imported peat was 4 times that of domestically produced packaged peat, these values are not comparable because of different marketing levels. Also, imported peat has different physical properties than most of the domestic peat, and it is usually sold on a volume basis rather than by weight. Each 100 pounds of a typical air-dryed imported peat will measure approximately 12 bushels, whereas the same weight of a typical domestic peat will measure only 3 or 4 bushels. A few domestic operations produced peat with properties similar to those of the imported kind.

Peat is broadly classified in the United States as moss peat, reed-sedge peat, and humus, varying with the different type of plant materials from which it has been formed and its degree of decomposition. Moss peat is a type that has been formed principally from sphagnum, hypnum, and/or other mosses; reed-sedge peat originated mainly from reeds, sedges, and other swamp plants; and humus peat is too decomposed for identification of its biological origin.

FOREIGN TRADE

The quantity of peat imported into the United States in 1974 totaled 327,000 short tons. This was up 1% from the peat imported in 1973 and was the largest quantity imported in any year to date.

Canada provided the bulk of the peat imports, supplying 96% of the total. Virtually all of the remaining foreign peat was supplied by Europe.

European shipments decreased 17%, principally because of a substantial drop in receipts from West Germany. West Germany supplied 97% of the peat imported from Europe.

Imported peat was classified according to use, either as poultry- and stable-grade peat or as fertilizer-grade peat. Of the total imported, 99% was fertilizer-grade peat. Except for a duty of $0.50 per long ton levied on poultry and stable-grade peat from centrally controlled economy countries, there was no tariff on peat.

Foreign peat entered the United States through 26 customs districts in 1974, but 84% of the total was shipped through the Buffalo and Ogdensburg, N.Y.; Detroit, Mich.; Pembina, N. Dak.; St. Albans, Vt.; and Seattle, Wash., customs districts. The largest quantity 90,000 tons, was shipped through the Ogdensburg district.

Table 7.—U.S. imports for consumption of peat moss, by grade and country

Country	Poultry and stable grade		Fertilizer grade		Total	
	Quantity (short tons)	Value (thousands)	Quantity (short tons)	Value (thousands)	Quantity (short tons)	Value (thousands)
1973						
Canada	4,718	$271	301,887	$17,475	306,605	$17,746
Germany, West	1,104	66	15,012	870	16,116	936
Guyana	--	--	18	1	18	1
Hong Kong	7	20	--	--	7	20
Ireland	13	10	172	18	185	28
Japan	--	--	50	2	50	2
Netherlands	--	--	7	1	7	1
Norway	3	4	--	--	3	4
Poland	--	--	332	17	332	17
Thailand	--	--	19	1	19	1
U.S.S.R	17	1	114	4	131	5
United Kingdom	--	--	21	1	21	1
Venezuela	--	--	7	(1)	7	(1)
Total	5,862	372	317,639	18,390	323,501	18,762
1974						
Canada	2,667	226	309,221	21,429	311,888	21,655
Finland	--	--	14	8	14	8
Germany, West	580	38	12,816	822	13,396	860
Honduras	--	--	15	(1)	15	(1)
India	2	1	--	--	2	1
Ireland	18	1	--	--	18	1
Japan	--	--	752	34	752	34
Netherlands	--	--	1	1	1	1
Poland	--	--	157	16	157	16
United Kingdom	--	--	287	6	287	6
Total	3,267	266	323,263	22,316	326,530	22,582

[1] Less than ½ unit.

Table 8.—U.S. imports for consumption of peat moss in 1974, by grade and customs district

Customs district	Poultry and stable grade		Fertilizer grade		Total	
	Quantity (short tons)	Value (thousands)	Quantity (short tons)	Value (thousands)	Quantity (short tons)	Value (thousands)
Baltimore, Md	--	--	1,071	$78	1,071	$78
Boston, Mass	--	--	104	5	104	5
Buffalo, N.Y	356	$28	23,929	1,538	24,285	1,566
Charleston, N.C	55	3	12	(1)	67	3
Cleveland, Ohio	--	--	38	9	38	9
Detroit, Mich	258	13	58,493	4,155	58,751	4,168
Duluth, Minn	13	1	4,256	466	4,269	467
Great Falls, Mont	--	--	11,568	835	11,568	835
Houston, Tex	--	--	1,390	104	1,390	104
Los Angeles, Calif	91	7	2,350	149	2,441	156
Miami, Fla	--	--	44	2	44	2
Mobile, Ala	16	1	136	9	152	10
New Orleans, La	--	--	2,995	173	2,995	173
New York, N.Y	16	1	1,565	73	1,581	74
Norfolk, Va	--	--	639	42	639	42
Ogdensburg, N.Y	32	2	89,920	5,615	89,952	5,617
Pembina, N.Dak	1,242	106	17,544	1,141	18,786	1,247
Philadelphia, Pa	78	5	694	50	772	55
Portland, Maine	613	66	20,077	1,365	20,690	1,431
Portland, Oreg	48	4	--	--	48	4
St. Albans, Vt	171	10	36,164	2,287	36,335	2,297
San Francisco, Calif	36	2	321	24	357	26
San Juan, P.R	--	--	897	66	897	66
Savannah, Ga	168	12	124	8	292	20
Seattle, Wash	--	--	47,402	4,018	47,402	4,018
Tampa, Fla	74	5	1,530	104	1,604	109
Total	3,267	266	323,263	22,316	326,530	22,582

[1] Less than ½ unit.

Table 9.—Peat moss imported for consumption from Canada and West Germany in 1974, by grade and customs district

Customs district	Canada				West Germany			
	Poultry and stable grade		Fertilizer grade		Poultry and stable grade		Fertilizer grade	
	Quantity (short tons)	Value (thousands)	Quantity (short tons)	Value (thousands)	Quantity (short tons)	Value (thousands)	Quantity (short tons)	Value (thousands)
Baltimore, Md	--	--	--	--	--	--	1,056	$69
Boston, Mass	--	--	--	--	--	--	104	5
Buffalo, N.Y	338	$27	23,929	$1,538	--	--	--	--
Charleston, N.C	--	--	--	--	55	$3	12	(¹)
Cleveland, Ohio	--	--	38	9	--	--	--	--
Detroit, Mich	258	13	58,493	4,155	--	--	--	--
Duluth, Minn	13	1	4,256	465	--	--	--	--
Great Falls, Mont	--	--	11,515	831	--	--	--	--
Houston, Tex	--	--	--	--	--	--	1,311	97
Los Angeles, Calif	--	--	--	--	88	6	1,598	116
Miami, Fla	--	--	--	--	--	--	29	1
Mobile, Ala	--	--	--	--	16	1	136	9
New Orleans, La	--	--	117	7	--	--	2,800	158
New York, N.Y	--	--	--	--	16	1	1,565	73
Norfolk, Va	--	--	--	--	--	--	639	42
Ogdensburg, N.Y	32	2	89,701	5,614	--	--	--	--
Pembina, N.Dak	1,242	107	17,544	1,141	--	--	--	--
Philadelphia, Pa	--	--	--	--	78	5	694	50
Portland, Maine	613	66	--	--	--	--	--	--
Portland, Oreg	--	--	20,077	1,365	48	4	--	--
St. Albans, Vt	171	10	36,164	2,287	--	--	--	--
San Francisco, Calif	--	--	--	--	37	2	321	24
San Juan, P.R	--	--	--	--	--	--	397	66
Savannah, Ga	--	--	--	--	168	11	124	8
Seattle, Wash	--	--	47,387	4,017	--	--	--	--
Tampa, Fla	--	--	--	--	74	5	1,530	104
Total	2,667	226	309,221	21,429	580	38	12,316	822

¹ Less than ½ unit.

WORLD REVIEW

World production of peat in 1974 was estimated at 220 million short tons, remaining at practically the same level as the revised output reported for 1973.

The U.S.S.R. was by far the largest peat producer, with an estimated 96% of the world production. According to published U.S.S.R. figures, 145 million tons of peat was produced by state enterprises for agricultural use, and an estimated 66 million tons was used for fuel. Agricultural peat was used for general soil improvement and the manufacture of fertilizers, and fuel peat was used for generating electric power and for domestic and industrial heating.

Ireland ranked second in peat production, with an estimated output of 4 million short tons. Virtually all of Ireland's production was fuel peat that was used for generating electric power and for heating households. A small amount of agricultural peat was produced, principally for export.

West Germany, the third-ranking peat producer with 2.3 million tons, provided about 2% of the world output. Most of the West German production was agricultural peat, with only 10% consumed as a fuel.

Other producers, ranking in output in the order named, were the United States, Finland, the Netherlands, and Canada. The combined output of these countries was, however, only 1% of the world total. Although the United States was fourth in world production, its output was less than one-half percent of the world total.

Table 10.—Peat: World production, by country

(Thousand short tons)

Country [1]	1972	1973	1974 ^{p}
Argentina, agricultural use	7	11	^{e} 17
Canada, agricultural use	376	359	391
Denmark, fuel ^{e}	6	6	6
Finland:			
Agricultural use	140	171	^{e} 175
Fuel	166	265	^{e} 275
France, agricultural use	^{r} 120	$^{r\ e}$ 140	^{e} 140
Germany, West:			
Agricultural use	^{r} 1,850	1,937	^{e} 2,100
Fuel	318	308	206
Hungary, agricultural use ^{e}	72	72	72
Ireland:			
Agricultural use	^{e} 70	85	^{e} 88
Fuel	$^{r\ e}$ 5,500	4,245	^{e} 4,200
Israel, agricultural use ^{e}	22	22	22
Japan ^{e}	80	80	80
Korea, Republic of, agricultural use	4	4	^{e} 4
Netherlands ^{e}	440	440	440
Norway:			
Agricultural use	13	$^{r\ e}$ 13	^{e} 14
Fuel ^{e}	6	6	6
Poland:			
Agricultural use ^{e}	55	40	40
Fuel ^{e}		10	10
Spain	18	17	^{e} 17
Sweden:			
Agricultural use	^{r} 72	75	^{e} 77
Fuel	36	31	^{e} 33
U.S S.R.:			
Agricultural use ^{e}	^{r} 143,700	146,700	145,100
Fuel	^{r} 67,500	^{e} 64,500	^{e} 66,100
United States, agricultural use	577	635	731
Total	^{r} 221,143	220,172	220,344
Fuel peat included in total	^{r} 78,522	69,371	70,836

^{e} Estimate. ^{p} Preliminary. ^{r} Revised.

[1] In addition to the countries listed, Austria, Canada, Iceland, and Italy produce a negligible quantity of fuel peat. No data are available for East Germany, a major producer.

TECHNOLOGY

Results of research conducted by the State of Minnesota at Wilderness Valley Farms and at the Virginia sewage treatment plant, together with technical advice from Dr. Rouse Farnham of the University of Minnesota, led to the construction of peat-over-sand sewage treatment filters at four U.S. Forest Service campgrounds in Minnesota. These sewage treatment facilities have been in operation since January 1973, and have been constantly monitored under Environmental Protection Agency (EPA) requirements. Results show that the filters meet all EPA guidelines, removing 99.8% of the phosphates and nitrogen and eliminating almost 100% of the Biochemical Oxygen Demand and coliform bacteria. The peat-over-sand filters are inexpensive and effective and are capable of handling the sewage produced from a community of up to 3,500 people.[2]

The Minnesota Gas Co. has proposed to convert peat into synthetic natural gas (SNG), following preliminary studies and research conducted by the Institute of Gas Technology on peat gasification. Gas can be produced from the incomplete combustion of peat in the presence of hot air and steam. The resulting gases are cleansed of ash and tar by means of scrubbers, and pure ammonia and hydrogen sulfate are produced as byproducts. The remaining gases undergo a shift conversion, producing an intermediate calorific gas which is upgraded by a methanation process to SNG.

The Minnesota Gas Co. has applied for a 25-year lease from the Minnesota Department of Natural Resources on 200,000 acres of State-owned peat bogs, averaging about 7½ feet in thickness.

Further research needs to be conducted to determine the economic feasibility of producing SNG from peat. If the process is proved to be commercially feasible, a demonstration plant is planned with a capacity of up to 80 million cubic feet per day (MMCFD).

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[2] Department of Iron Range Resources and Rehabilitation, State of Minnesota. Biennial Report 1972–1974. P. 15.

A full-scale peat gasification plant would produce an estimated 250 MMCFD, equal to an annual output of approximately one quarter of the natural gas consumed in the State in 1974. An operation of this size would have an estimated 20-year supply of peat available from the requested lease, if the plant was operated on a continuous basis.[3]

In experimental research conducted at British Columbia Research, Vancouver, Canada, Canadian sphagnum peat moss was tested for its adsorption capacity of odorous gases. In these studies, 20-mesh sphagnum peat was first degassed by heating to 103° C for 6 hours, after which its capacity was compared with that of Dargo G-60, an adsorption type of 20 to 40 mesh activated charcoal.

Three gases–dimethylamine, ammonia, and hydrogen sulfide—were chosen as test materials because of their odor and extensive use in many industrial operations. These gases, using helium as a carrier, were passed through adsorption columns filled with equal volumes of peat or activated charcoal. The experiments were monitored by a thermal conductivity detector, and results indicated that peat had 30% to 38% the adsorption capacity of activated charcoal on a volume basis. On a weight basis, however, peat had 80% to 97% the adsorption capacity of activated charcoal.

According to British Columbia Research, the capacity of peat as an adsorbent of odorous gases has several disadvantages when compared with the capacity of activated charcoal. Because peat is only 2.6 times as dense as activated charcoal by weight, a peat filter would have to be almost 3 times bulkier than one of activated charcoal to achieve the same effectiveness. Also, the effective life of peat filters were found to be only 14% to 23% as long as the life of activated charcoal filters. This means that peat filters would have to be replaced 4 to 7 times more often than those of activated charcoal. British Columbia Research concluded from the studies that sphagnum peat was not a feasible substitute for activated charcoal for adsorbing odorous gases.[4]

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[3] International Gas Technology Highlights. V. 5, No. 16, Aug. 4, 1975, p. 1.

[4] Soniassy, R. N. Adsorption of Odours by Peat Moss. Can. Min. and Met. Bull., v. 67, August 1974, pp. 95–98.

Perlite

By Arthur C. Meisinger [1]

A record quantity (555,000 tons) and value ($7.0 million) for crude perlite sold and used were set in 1974 by the domestic industry. The previous record year was 1972. Deposits in New Mexico supplied 88% of the total crude perlite ore mined (676,000 tons) in 1974.

The value of expanded perlite sold or used at 76 plants in 30 States was a record $30.7 million, compared with $28.0 million in 1973 and the previous record of $28.4 million in 1972. Illinois continued to be the leading State in the production of expanded perlite.

Grefco, Inc., announced plans to reopen its Socorro, N. Mex., perlite operation, which is expected to be on-stream by late 1975.

Table 1.—Crude and expanded perlite produced and sold or used by producers in the United States

(Thousand short tons and thousand dollars)

Year	Crude perlite						Expanded perlite		
	Quantity mined	Sold		Used at own plant to make expanded material		Total quantity sold or used	Quantity produced	Sold or used	
		Quantity	Value	Quantity	Value			Quantity	Value
1970 ----	607	176	2,056	280	2,848	456	420	416	24,972
1971 ----	495	175	2,062	257	2,879	432	389	385	23,156
1972 ----	649	224	2,540	321	3,691	545	427	421	28,397
1973 ----	759	238	2,771	306	2,819	544	424	418	28,005
1974 ----	676	275	3,544	280	3,480	555	423	419	30,747

DOMESTIC PRODUCTION

Production of crude perlite in 1974 was reported by 11 companies in 6 States, 1 less than in 1973. Twelve mines were in operation—the same as in 1973. The quantity of crude ore mined in 1974 was 676,000 tons, or 12% below the record quantity of 759,000 tons in 1973. New Mexico, with 88% of the U.S. crude perlite mined, continued to be the principal producing State, followed by Arizona, California, Nevada, Colorado, and Idaho in descending order.

A record quantity of 555,000 tons of crude perlite was sold and used in 1974. The previous record quantity was 545,000 tons in 1972. Value of crude perlite sold and used was also a record figure of $7.0 million, and exceeded by $793,000 the previous high value of $6.2 million in 1972.

As in 1973, perlite was expanded at 76 plants in 30 States. The quantity produced was 1,000 tons less than the 424,000 tons produced in 1973, and the quantity sold or used (419,000 tons) was 1,000 tons more than that of 1973. The value of expanded perlite sold or used reached a record $30.7 million.

The leading States in descending order of expanded perlite production in 1974 were Illinois, Mississippi, Kentucky, Pennsylvania, Colorado, Florida, New Jersey, Texas, California, and Indiana.

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[1] Industry economist, Division of Nonmetallic Minerals.

Grefco, Inc., Los Angeles, Calif., announced plans to reopen its Socorro perlite deposit and processing plant. Mining was begun at Socorro in 1947, and was discontinued in 1961 when operations were consolidated at No Agua, N. Mex., and Antonito, Colo. The Socorro facilities are expected to be operational in late 1975.

Table 2.—Expanded perlite produced and sold by producers in the United States

State	1973				1974			
	Quantity produced (short tons)	Sold or used			Quantity produced (short tons)	Sold or used		
		Quantity (short tons)	Value (thousands)	Average value per ton		Quantity (short tons)	Value (thousands)	Average value per ton
California	24,442	23,652	$2,071	r $87.56	23,001	21,137	$1,978	$93.60
Florida	23,378	22,613	1,287	56.92	24,006	24,038	1,403	58.37
Indiana	14,878	14,801	1,021	69.01	16,212	15,753	1,070	67.92
Kansas	900	893	97	108.87	580	580	101	174.14
Missouri	3,930	3,930	362	92.24	6,000	5,906	475	80.43
New York	6,526	6,128	495	80.70	4,988	4,988	516	103.45
Ohio	12,099	12,099	748	61.85	12,138	12,138	825	67.97
Pennsylvania	36,490	35,230	2,055	58.33	38,204	39,232	2,684	68.41
Texas	18,273	18,452	1,210	65.57	22,286	22,141	1,575	71.13
Other States [1]	282,646	280,053	18,659	66.63	275,450	273,583	20,120	73.43
Total	423,562	417,851	28,005	67.02	422,865	419,496	30,747	73.29

[1] Includes Colorado, Georgia, Idaho, Illinois, Iowa, Kentucky, Louisiana, Maine, Maryland, Massachusetts, Michigan, Minnesota, Mississippi, Nebraska, Nevada, New Hampshire, New Jersey, Oregon, Tennessee, Utah, and Wisconsin.

CONSUMPTION AND USES

Consumption of expanded perlite in 1974 was 419,500 tons, or 1,645 tons more than in 1973. The percent disposition by end use is shown in table 3. Filter aids was again the principal use for expanded perlite, although showing a decline of 2% from 1973 consumption. Plaster and concrete aggregates, combined, at 17% were unchanged. Other primary end uses for expanded perlite showed gains in 1974, with the exception of fillers (1% decline) and formed products (no change). Other uses totaled 42% compared with 46% in 1973, and included primarily insulation board and such uses as paint textures, foundry castables and bonding agents, polishing compounds, and fines for various industrial applications.

Table 3.—End use of expanded perlite

(Percent)

Use	1973	1974
Filter aid	19	17
Plaster aggregate	10	9
Concrete aggregate	7	8
Horticultural aggregate	5	6
Low-temperature insulation	2	5
Masonry and cavity fill insulation	1	4
Fillers	2	1
Formed products	8	8
Other [1]	46	42

[1] Includes insulation board.

PRICES

Producers sold crushed, cleaned, and sized crude perlite at expanding plants at an average price of $12.89 per ton in 1974, and that portion used by producers in their own expanding plants was valued at an average of $12.43 per ton. The weighted average price of both categories was $12.66 per ton—an increase of $2.38 over that of 1973.

Expanded perlite sold or used, according to expanders, increased in average value by 9.5% in 1974, compared with the 1973 average value of $67.02 per ton. Average values by States in 1974 ranged from $28 to $174 per ton, compared with the 1973 range of $34 to $151 per ton.

WORLD REVIEW

Greece.—Although data on perlite production were not available for 1974, a substantial increase in the production of both crude and screened perlite was achieved in 1973, compared with that of 1972. Crude perlite production in 1973 was 273,300 tons, or 136,800 tons more than in 1972. Processed (screened and sized for export) perlite production was 138,600 tons in 1973, compared with 120,300 tons in 1972.

Hungary.—Production of crude perlite was 105,500 tons in 1973, compared with the last reported production of 67,100 tons in 1971. Data on perlite production in 1974 were not available.

Mexico.—The country produced approximately 14,900 tons of crude perlite in 1973, compared with 14,200 tons in 1972. Production data for 1974 were not available, but were expected to be above the 1973 figure.

Taiwan.—A perlite-expanding plant was reported to be in operation in Taipei. The plant is owned by Kei Hsing Chemical Industries, Ltd., Taiwan.[2]

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[2] Perlite Institute, Inc. Bull. 17-75, Apr. 29, 1975.

Crude Petroleum and Petroleum Products

By William B. Harper,[1] Bernadette Michalski,[2] and Betty M. Moore [3]

CONTENTS

Page
- Salient statistics 941
- Crude petroleum 943
  - Production 943
  - Consumption 944
  - Productive capacity 944
  - Drilling activity 944
  - Reserves 945
- Refined products 946
  - Motor gasoline 946
  - Aviation fuels 947
  - Liquefied gases, ethane and ethylene 948
  - Kerosine 949
  - Distillate fuel oil 949
  - Residual fuel oil 949
  - Other products 950
- Transportation and distribution 951
  - Crude oil 951
  - Refined products 953
  - Pipelines 953
  - Rail, tank truck, barge, and tankers 953
  - Tanker rates 954
- Stocks 954
- Prices 954
- Foreign Trade 958
- Native asphalt 959
- World Review 959
- Technology 968

The energy supply situation in general and the petroleum-supply situation in particular became major concerns of the public soon after the Arab oil embargo began in 1973. That concern carried over into 1974. Although the embargo was lifted in March, the experience with long lines of cars at service stations had an impact on the consumer that did not moderate until mid-1974. With conservation a prime consideration, mild winter weather, and rising prices, domestic demand for petroleum products averaged 16.6 million barrels per day (bpd), nearly 4% less than the 17.3 million bpd of 1973 (each barrel contains 42 gallons).

Volumewise, most of the decline in demand was in residual fuel, distillate fuel, and motor gasoline. Refinery runs declined, but with demand down and imports at high levels, yearend stocks of most major products were substantially higher than those of 1973.[4]

Crude oil production in 1974, including lease condensate, declined to 8.8 million bpd, nearly 5% below the 1973 production of 9.2 million bpd. The reduction can be attributed at least in part to the gradual depletion of older fields, coupled with an inability to discover any major new fields.

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[1] Mineral industry specialist, Division of Petroleum and Natural Gas.

[2] Mineral specialist, Division of Petroleum and Natural Gas.

[3] Statistical assistant, Division of Fuels Data.

[4] Certain terms as used in this chapter are more or less unique to the petroleum industry. Principal terms and their meanings are—

Total demand.—A derived figure representing total new supply plus decreases or minus increases in reported stocks. Because there are substantial consumers' stocks that are not reported to the Bureau of Mines, this figure varies considerably from consumption as reported by the Federal Highway Administration of the Department of Transportation.

Domestic demand.—Total demand less exports.

New supply of all oils.—The sum of crude oil production, plus production of natural gas liquids, plus benzol (coke-oven) used for motor fuel, hydrogen, and other hydrocarbons, plus imports of crude oil and other petroleum products.

Transfers.—Crude oil conveyed to fuel-oil stocks without processing, or reclassification of products from one product category to another.

All oils.—Crude petroleum, natural gas liquids, and their derivatives.

Exports.—Includes shipments to the United States territories, possessions, and free trade zones.

Imports.—Includes receipts from the United States territories, possessions and free trade zones.

The decline in production made it necessary to increase imports in order to meet demand requirements. Imports of crude oil continued to rise. In 1974, crude oil imports averaged 3,477,137 bpd, which was 7% above 1973 imports and 56% higher than in 1972, when there was no embargo. Four lease sales were conducted in 1974 by the Bureau of Land Management of the U.S. Department of the Interior. These sales, held in March, May, July, and October, involved 1,762,158 acres, and the bonuses aggregated about $5 billion.

Drilling activity accelerated in 1974. The weekly activity of 1,474 rotary rigs was the highest in 10 years, according to the Hughes Tool Co. The American Petroleum Institute (API) reported there were 12,784 oil wells completed in 1974, an increase of 29%. The 7,240 gas wells drilled in 1974 was 13% higher than in 1973. It should be noted that a very large part of this rig activity related to infill development drilling; that is, drilling in known fields. Much of this activity was attributable to the "two-tier" pricing of crude oil. On one tier is "old" oil at $5.25 per barrel; on the other tier is "uncontrolled oil, classified as "new," "released," or "stripper," priced in December 1975 at $12.95 per barrel. Much of this development-well drilling involves production of new oil.

According to API estimates, reserves of crude oil declined for the fourth consecutive year as production withdrawals continued to outstrip additions to reserves. Reserves of 34.2 billion barrels at yearend 1974 represented a reserves-to-production ratio for crude oil of 11:1 (based on 1974 production). The largest single addition to reserves occurred in 1970 when the Alaska North Slope discoveries were included for the first time. Since World War II, reserves-to-production ratios have trended downward from a high of 13.6:1 in 1949 to a low of 9.2:1 in 1969.

Refinery throughout capacity at yearend 1974 amounted to 14.9 million bpd, up 4.9% from yearend 1973. Following the discontinuance of import quotas on crude oil and petroleum products in early 1973, many refiners announced expansion plans that could increase throughput capacity by nearly 1.2 million bpd by the end of 1976. Most of the proposed new capacity is scheduled to use imported crude oil.

Table 1.—Salient statistics of crude petroleum, refined products, and natural gas liquids in the United States

(Thousand 42-gallon barrels unless otherwise indicated)

	1970	1971	1972	1973	1974 p
Crude petroleum:					
Domestic production (including lease condensate)	3,517,450	3,453,914	3,455,368	3,360,903	3,202,585
World production	16,718,708	17,662,793	18,600,501	20,367,981	20,537,727
U.S. proportion . percent	21	20	19	17	16
Exports [1]	4,991	503	187	697	1,074
Imports [2]	483,293	613,417	811,135	1,183,996	1,269,155
Stocks, end of year	276,367	259,648	246,395	242,478	265,020
Runs to stills	3,967,508	4,087,809	4,280,863	4,537,254	4,428,726
Value of domestic product at wells:					
Total . thousands	$11,173,726	$11,692,998	$11,706,510	$13,057,905	$21,580,549
Average per barrel	$3.18	$3.39	$3.39	$3.89	$6.74
Total producing oil wells Dec. 31	530,990	517,318	508,443	497,378	497,631
Total oil wells completed during year (successful wells)	13,020	11,858	11,306	9,902	12,784
Refined products:					
Exports [1]	89,467	81,342	81,202	83,716	79,417
Imports (including unfinished oils and plant condensate) [3]	764,769	819,463	924,179	1,099,497	958,024
Stocks, end of year [4]	r 741,494	r 784,299	712,584	765,829	808,626
Completed refineries, end of year	r 281	r 279	277	284	NA
Daily crude-oil capacity	13,020	13,437	13,775	14,489	NA
Natural gas liquids:					
Production	r 605,241	617,815	638,216	634,423	616,098
Stocks, end of year	65,992	88,421	79,238	94,106	108,377
All oils:					
Total disposition of primary supply	5,463,259	5,638,853	6,076,846	6,406,613	6,154,751
Exports	94,458	81,845	81,389	84,413	80,491
Total domestic demand for products (including crude-oil losses)	5,368,801	5,557,008	5,994,957	6,322,200	6,074,260

p Preliminary (except for crude production and value). r Revised. NA Not available.

[1] U.S. Department of Commerce data.

[2] Reported to the Bureau of Mines.

[3] U.S. Department of Commerce data, Oil Import Administration and Federal Energy Administration except for unfinished oils and plant condensate, which are Bureau of Mines data.

[4] Stocks of refined products also include stocks of unfinished oils, natural gasoline, plant condensate, and isopentane.

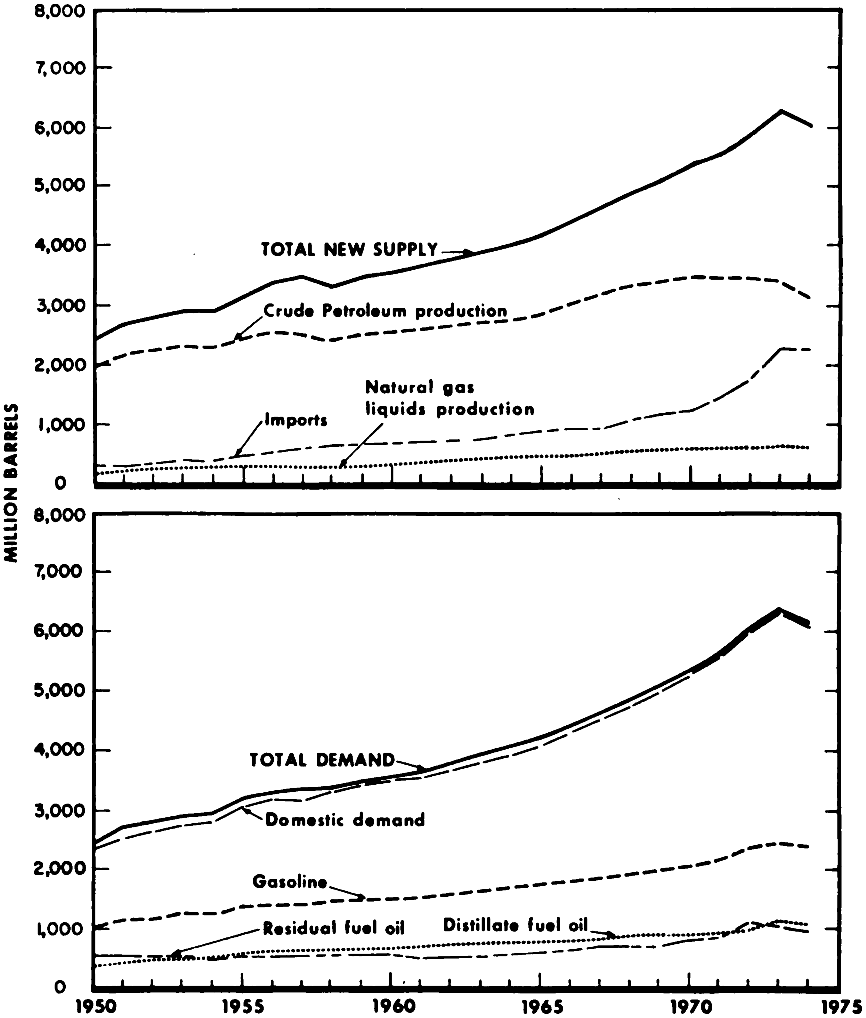

Figure 1.—Supply and demand of all oils in the United States.

CRUDE PETROLEUM

PRODUCTION

Production of crude oil (including lease condensate) in 1974 continued the downtrend that began after 1970. Total production in 1974 was about 3.2 billion barrels, nearly 5% below that of 1973. There were declines in 18 of the 31 oil-producing States. The sharpest decline occurred in the gulf coast region of Louisiana, which had a drop of 93 million barrels, or nearly 12%. In Texas, gains in Texas Railroad Commission district 06 (excluding East Texas) and district 08A (West Texas) failed to offset declines in other districts, so there was a net decline in 1974 of 32.5 million barrels.

The decline continued in 1975. On the plus side production rose 6.7 million barrels, or nearly 21% in Utah, and production in Florida continued to increase (11%) to 36.4 million barrels in 1974. Other comparisons are shown in table 5. In early 1975, production in Michigan was substantially above 1974 levels; likewise, Florida continued to make gains over the 1974 production levels.

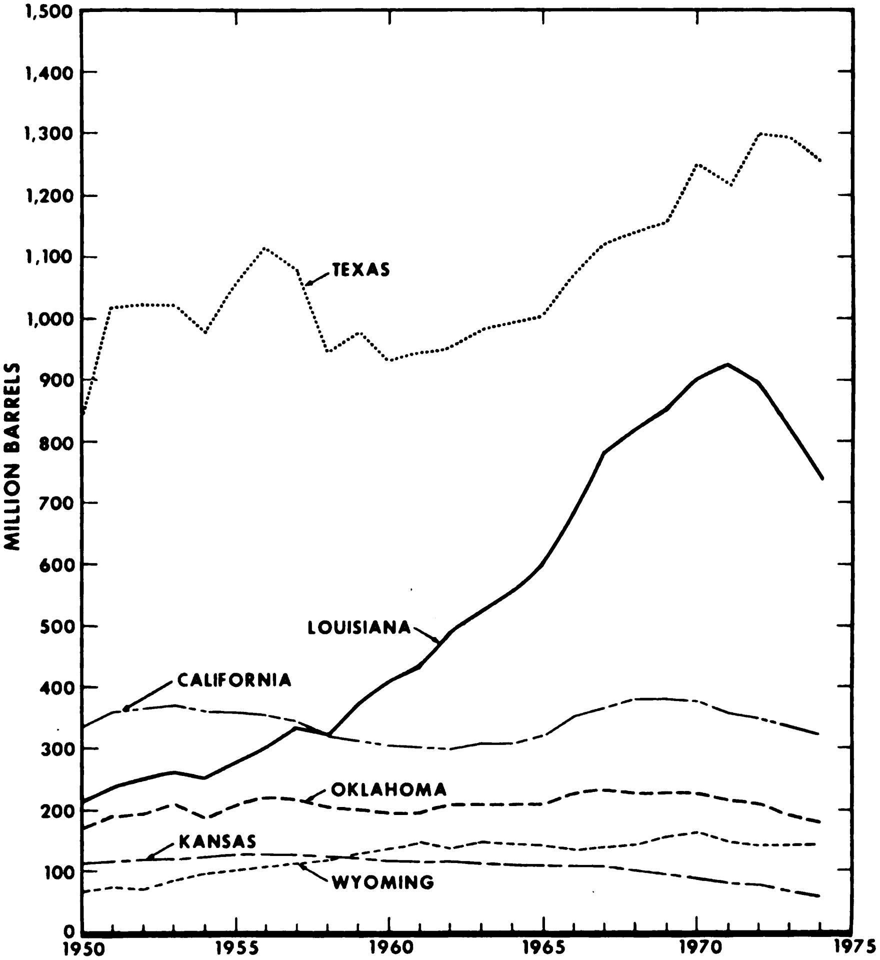

Figure 2.—Production of crude petroleum in the United States, by principal producing States.

CONSUMPTION

Crude oil refineries processed 4.4 billion barrels (12.1 million bpd) of crude oil, of which 71.5% was domestic crude and lease condensate and 28.5% originated in foreign countries (table 16). Based on operable refinery capacity as of January 1, 1974, of 14.4 million bpd, refineries in the United States operated at 85.3% of capacity during 1974.

PRODUCTIVE CAPACITY

According to API, the maximum crude oil output that could be attained in the United States as of December 31, 1974 was about 8.9 million bpd. This was the lowest since 1960 and 8.7% less than that on December 31, 1973. Texas and Louisiana suffered a combined loss of 771,000 bpd. Florida, Michigan, Utah, and Ohio increased productive capacity by a total of 45,000 bpd. These estimates were based on the assumption that such production could be achieved in 90 days with existing wells, well equipment, and present surface facilities, plus work changes that could be accomplished within that time. No productive capacity was credited to the North Slope of Alaska since there is no way to market the oil until the trans-Alaska Pipeline is operational.

For many years, the United States had a surplus productive capacity that could be called on to meet emergency needs, but with production declining and demand rising, there is little likelihood of a return to excess production capacity within the foreseeable future.

DRILLING ACTIVITY

Drilling activity revived markedly in 1974 and successful oil and gas completions totaled 20,024 wells, a 23% increase. Most of these gains occurred in oil well completions; this was the first time in 10 years that the yearend total was higher than at the end of the previous year. There were 12,784 oil wells completed in 1974, a 29% increase of nearly 2,900 wells. Gas well completions were up 855, 13% above the 1973 results.

Development well completions increased 29% above 1973 levels and accounted for 11,970 wells, or nearly 94% of total oil well completions in 1974. More than 4,100 (34%) of the total successful oil wells were completed in Texas. More than 1,600 of the Texas total were located in Texas Railroad Commission districts 08 and 08A in West Texas. California was second in importance with 1,539 oil well completions, a 78% increase over 1973 levels. East-central California accounted for about 1,200 of the completions in that State. In Oklahoma, development-well drilling revived; there were nearly 1,100 completions compared with 860 in 1973.

Development oil well completions for 1970–75 are shown in the following tabulation, by quarter:

Year	Jan.–Mar.	Apr.–June	July–Sept.	Oct.–Dec.	Total[1]
1970	3,088	2,948	3,115	3,125	12,230
1971	2,804	2,679	2,617	3,089	11,207
1972	2,789	2,726	2,664	2,452	10,622
1973	2,310	2,093	2,333	2,542	9,283
1974	2,417	2,949	3,196	3,396	11,970
1975	3,515	3,270	3,755	4,868	15,436

[1] Quarterly reports, as published do not add to totals shown because of subsequent revisions.

Source: Quarterly Review of Drilling Statistics for the United States. American Petroleum Institute, Washington, D.C.

The uptrend in oil well drilling continued in 1975 and there were 15,436 development wells, a 29% increase over 1974.

There were about 497,631 oil wells producing at the end of 1974 compared with 497,378 at yearend 1973. This is the first time in nearly a decade that an increase occurred in the number of oil wells producing. From 589,203 wells in 1965, the number eroded to the low in 1973.

Stripper wells, which are wells producing 10 bpd or less of oil, accounted for about 355,000, or 70%, of all oil wells. Production of all producing oil wells averaged 17.6 bpd in 1974.

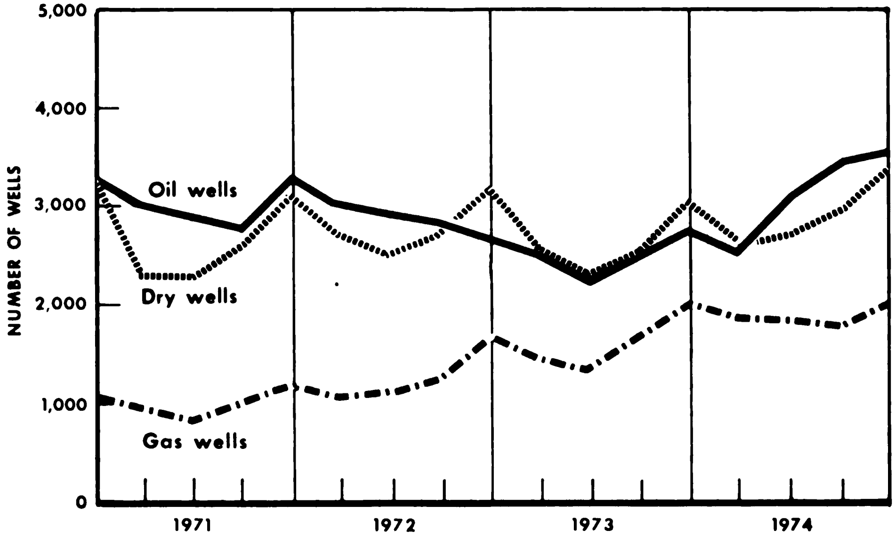

Figure 3.—Wells drilled for oil and gas in the United States, by quarter.

RESERVES

The API Committee on Petroleum Reserves and Productive Capacity estimated proved recoverable reserves of crude oil as of December 31, 1974, to be 34,250 million barrels, a decline of 1,050 million barrels for the year.

Gains in proved reserves occurred in seven States, led by Florida, which added 119 million barrels. Losses in proved reserves occurred in 16 States. In those States having significant reserves, the largest losses occurred in Texas (755 million barrels), Louisiana (350 million barrels), Oklahoma (39 million barrels), and Mississippi (nearly 30 million barrels).

According to API, indicated additional reserves from known reservoirs amounted to 4,636 million barrels. These are potentially available crude oil reserves in known reservoirs in excess of the proved reserves. Engineering knowledge and judgment indicate that these additional reserves will be economically available by application of fluid injection and other improved recovery techniques. Most of the indicated additional reserves were in Texas (2,032.6 million barrels), California (1,348.6 million barrels), New Mexico (311.5 million barrels), Louisiana 224.5 million barrels), and Oklahoma (205 million barrels).

In addition to proved reserves and indicated reserves, there are "inferred" reserves and estimates of undiscovered recoverable resources. The U.S. Geological Survey estimated inferred reserves at 23.1 billion barrels as of December 31, 1974. These reserves are estimated to be recoverable in the future as a result of extensions and revisions of estimates and new pays in known fields beyond those shown in indicated reserves shown in table 12. The category of undiscovered recoverable resources includes deposits that are yet to be discovered but are assumed to be economically producible. These resources also include deposits that are already identified but cannot be extracted now because of economic or technological factors. It should be noted that the estimates shown in table 13 are based on price-cost relationships and technological trends prevailing in the recent years prior to 1974.

Crude Supply.—Total receipts of crude oil at refineries in 1974 were 4,436.3 million barrels, or 12.2 million bpd, a decrease of 109.5 million barrels, or 300,000 bpd, for the year. Refinery runs to stills decreased 108.5 million barrels, or 297,000 bpd, in 1974 as shown in table 18. Overland receipts of foreign crude oil (from Canada) were 76.6 million barrels lower in 1974; foreign receipts from overseas sources increased 161.8 million barrels, or 443,200 bpd.

More foreign overseas crude oil entered refineries in all PAD districts in 1974 because domestic crude oil was in short supply. Refineries processed 4,428.7 million barrels of crude oil in 1974, reported a net of 1.3 million barrels used for refinery fuel and as losses, and added 6.3 million barrels to stocks (table 18).

REFINED PRODUCTS

The Arab oil embargo was in full effect during the first 3 months of 1974, significantly reducing imports of crude oil and refined products below normal levels and causing some shortages. Although imports resumed after March, gasoline demand revived slowly. The recession also caused demand to taper off. As a result, overall domestic demand for petroleum products in 1974 dropped 3.9% to 16.6 million bpd, from the 17.3 million bpd in 1973.

MOTOR GASOLINE

Restrictions on availability of motor gasoline in the first quarter of 1974 had a traumatic effect on gasoline buyers through June 1974. As a result, gasoline demand did not revive until July. Hence, in 1974, gasoline demand declined to 6.5 million bpd, or 137,000 bpd below that of 1973, but still above 1972 levels. During this period, Federal Energy Administration (FEA) gasoline supply and use restrictions were in effect. Under the Emergency Petroleum Allocation Act of 1973 (P.L. 93-159), FEA set up allocation levels for fuels (including gasoline). The allocation level for each wholesale purchaser was 100% of current requirements for certain priority uses, such as energy production, emergency uses, agriculture, and transportation. Other businesses, such as industrial, commercial, governmental, and social-agency users, were to receive 100% of 1972 consumption. There was also a 3% State set-aside to provide a reserve for emergency needs; it was to be administered by the States. Still other factors contributing to soft demand have been rising gasoline prices and the impact of the recession on the use of passenger cars, trucks, and buses.

Motor fuel consumption in the United States during 1974, as estimated by the Federal Highway Administration, averaged 7.2 million bpd. This differs from the Bureau of Mines estimate of 6.5 million bpd because the Bureau data did not include changes in secondary stocks. Gasoline users, after waiting in long lines at gasoline service stations during late 1973 and early 1974, adopted a new policy of operating cars with full or nearly full gasoline tanks. The allocation however, of gasoline by priority was unnecessary in 1974 because supplies increased. When demand failed to offset production, refiners cutback on gasoline production.

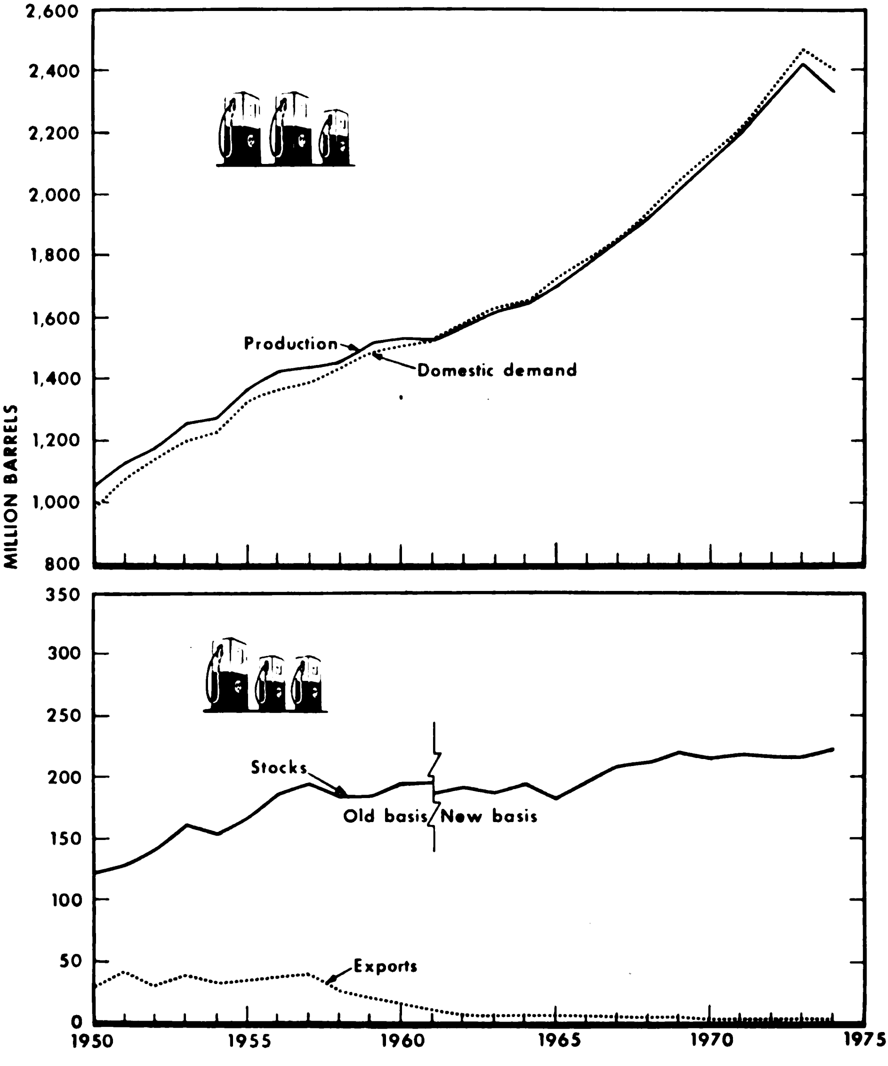

Figure 4.—Production, domestic demand, stocks, and exports of gasoline in the United States.

AVIATION FUELS

Aviation Gasoline.—The downtrend in demand, which dates back nearly a decade, appears to have leveled off. With the transition from piston to jet and propeller-jet engines, demand shrank 63% from 120,000 bpd in 1965 to 44,000 bpd in 1974. Over this period, airline use of aviation gasoline declined from 33,000 to 4,200 bpd; military use declined from 60,000 to 13,700 bpd. Military use accounted for 53% of demand in 1965 and about 31% in 1974 as shown in table 27.

Commercial Jet Fuel.—By far, the greatest use of kerosine is in commercial kerosine-type jet fuel. This product is a kerosine with restrictions on the content of aromatics and naphthas as stipulated in ASTM-D1655 specifications. The product has a very low freezing point and includes military JP-5 jet fuel.

The drastic cuts in commercial airline flights resulting from the Arab oil embargo had a severe impact on use of commercial jet fuel. Shipments of this fuel dropped nearly 8% from 753,000 to 694,000 bpd in 1974 as evidenced in table 28.

About 26,000 bpd of naphtha-type jet fuel was used commercially, primarily by the airlines. Naphtha-type jet fuel is in the heavy-naphtha boiling range, with an average gravity of 52.8° API and 10% to 90% distillation at 210° F to 420° F, and conforms to ASTM–D1655 and military specifications MIL–F–5624 and MIL–T–56246. It includes military jet fuel, JP–4. Military use of jet fuel in 1974 averaged 234,000 bpd, slightly less than the 235,700 bpd of 1973. However, shipments of naphtha-type jet fuel were nearly 8 million barrels higher in 1974 than in 1973. In addition, the military imported another 8 million barrels into PAD districts I and V.

The allocation program, administered by FEA, was changed as more supplies became available. The most recent change occurred in July 1974. Under the revision, applicable to aviation fuels, 100% of requirements were allotted to the Department of Defense. Agricultural production flying, emergency aviation service, safety and energy missions, energy production flying, telecommunications flying, and aircraft manufacture were allotted 100% of current requirements as reduced by an allocation fraction. All other categories since July 1974 received 100% of base-period use, as reduced by an allocation fraction.

Peaking Unit Use.—In addition to the conventional uses of kerosine-type jet fuel, the use of jet engines as gas turbines to generate electric power is expanding, but use of jet fuel is decreasing. For example, about 4.3 million kilowatts of capacity in gas turbine plants was either in the planning stage or under construction in 1974. Another 1.5 million kilowatts was scheduled for 1975. Conversely, nearly 5.2 million barrels of kerosine-type jet fuel was used by electric utility companies in 1974, 6.3 million barrels in 1973, and 8.8 million barrels in 1972. Data for previous years are not available. Virtually all of the kerosine-type jet fuel was used in peaking units of electric utilities. Although gas turbine capacity of peaking units has expanded, the sharp increase in prices is inducing the utilities to use Nos. 2 and 4 distillates and cutback on use of commercial kerosine-type jet fuel.

LIQUEFIED GASES, ETHANE, AND ETHYLENE

Liquefied gases are derived from two sources; those produced at refineries are called liquefied refinery gases to distinguish them from liquefied petroleum gases obtained by processing natural gas. The liquefied petroleum gases (LPG) are all paraffins (propane, butane, and isobutane). The liquefied refinery gases (LRG) also contain paraffins, but may also contain unsaturated hydrocarbons; that is, the olefins (propylene, butylene, ethylene, etc.). The paraffins may be used as fuel (including as a blend with motor gasoline) or as feedstock at petrochemical plants. The olefins are used primarily as petrochemical feedstocks.

Demand for ethane (including ethylene) increased 4.3% in 1974. Use of ethane as petrochemical feedstock increased demand from 327,200 bpd in 1973 to 341,300 bpd in 1974.

Domestic demand for LPG and LRG in 1974, excluding that blended into other products at refineries or terminals, was 1,063.7 million bpd compared with 1,121.4 million bpd in 1973. Propane accounted for 78% of liquefied gas demand in 1974.

Major natural gas consumers (industrial firms, electric powerplants, and natural gas utilities), fearing a shortage of natural gas, sought propane as a substitute or standby fuel and were active propane purchasers. This represented a significant demand for propane and some diversion of propane from established markets.

A mandatory propane allocation program was effected on October 3, 1973. This program has been successful in terms of supply. Propane was available during the heating season because of the combined effects of allocation, high prices, mild winter weather, and the economic recession. Furthermore, stocks of propane, totaled 64.7 million barrels at yearend, which was 8% over those of 1973. In 1975, however, production of propane and other natural gas liquids was affected by the decline in natural gas production.[5]

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[5] Data are available for 1975 in the following Bureau of Mines, Mineral Industry Surveys: Natural Gas, Monthly; Natural Gas Liquids, Monthly; Petroleum Statement, Monthly.

KEROSINE

A mild winter coupled with changeovers to other types of heating contributed to the 18.5% drop in demand to 176,300 bpd. In 1974, refiners cutback on production 62,400 bpd, or 29% less than the 1973 level of about 280,000 bpd. The same allocation regulations applicable to distillate fuel oil applied to kerosine.

The primary use for kerosine (including range oil) is space heating. Although space heating accounted for 78% of the domestic demand for kerosine, that demand has been in a downtrend for many years. However, this trend may be arrested or begin to flatten out if present users decide not to convert to the more convenient forms of energy such as LPG and electric power because of sharp increases in the prices of LPG and electricity.

DISTILLATE FUEL OIL

When produced in conventional distillation procedures, distillate has a boiling range from 10% at 300° F to 90% at 675° F. Included are Nos. 1 and 2 heating oils and diesel fuels. No. 4 fuel oil, which is a blend of distillate fuel oil and residual fuel oil, is used extensively in industrial plants because it does not require preheating.

Demand for distillate declined 5% to 2.9 million bpd in 1974. Most of this decline reflected reduced use of distillate for heating as shown in table 32, because of a mild 1973–74 winter. Some of the decline resulted from a lower demand for diesel fuel for on-highway use. Most uses of distillate were lower in 1974 except for sales to electric utility companies.[6] Most of this increase resulted from restrictions on the use of high-sulfur-content fuels such as coal and residual fuel oil. Utilities are also using sizable quantities of distillates in their gas-turbine and internal-combustion generating engines as shown in table 32.

Although stock levels, in terms of days' demand, were at low levels in March and April, inventories during the remainder of the year were at or above normal levels, as shown in table 33.

Allocation of distillate by FEA as amended July 1974 established the following priorities:

(1) Agricultural production, nonhousekeeping uses by the Department of Defense, and space-heating requirements of medical and nursing buildings for all purposes were allotted 100% of requirements.

(2) Emergency services, energy production, manufacture of ethical drugs and related research, sanitation services, telecommunications services, passenger transportation services, cargo, freight, and mail handling, aviation ground support vehicles and equipment, nonmilitary marine shipping, industrial uses except space heating, petrochemical-feedstock use, and space-heating requirements were allotted 100% of current requirements reduced by an allocation fraction.

(3) An amount of 100% of base-period use as reduced by an allocation fraction was allotted for synthetic natural gas (SNG) plant-feedstock use, electric utilities, and all other nonspace-heating uses.

RESIDUAL FUEL OIL

Residual fuel oil demand in 1974 declined 198,000 bpd, 7% below 1973 demand. Heating, which accounted for 17% of residual fuel oil demand, declined 68,000 bpd, or 12%, below 1973 levels; there was a 7% decrease of 95,000 bpd in electric utility use. Utilities accounted for nearly 50% of residual fuel oil sales in 1974. Some of this decline reflected a mild winter, but the economic recession was also a factor.

Domestic refinery production of residual fuel oil totaled 1.1 million bpd, a 10% increase over that of 1973 as shown in table 34. Residual oil with a sulfur content of less than 0.5% accounted for 267,592 bpd, or 25%, of production. Imports of residual oil were more than 100 million barrels, or 280,000 bpd less than in 1973. Residual fuel oil with less than 0.5% sulfur made up nearly 37% of residual fuel imports. Caribbean refiners supplied 435,000 bpd, or 80%, of low-sulfur residual fuel.

Stocks were at adequate levels. At the end of 1974, they were equivalent to a 20-day supply based on April 1975 demand, and equivalent to a 30-day supply compared with 21 days in April 1974.

Residual fuel oil allocations were similar in most instances to those previously outlined for distillate fuel oil. However, there were exceptions, such as the allocation level specified each month by FEA for utility use. In specifying allocation levels for each utility, FEA may include, but is not limited to, considerations such as the following: (1) Each utility shall absorb an equal percentage of the cutback in electricity generation; and (2) electric generating plants now burning residual fuel oil have been identified by FEA for conversion to coal.[7]

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[6] U.S. Bureau of Mines. Sales of Fuel Oil and Kerosine in 1974. Mineral Industry Survey, Sept. 11, 1975, 14 pp.

OTHER PRODUCTS

Petrochemical Feedstocks.—In 1974, petroleum refineries produced nearly 134.8 million barrels of petrochemical feedstocks. Domestic demand approximated 132.5 million barrels, slightly more than in 1973. Naphtha–400° constituted nearly 47% of demand in 1974, as indicated in table 35.

Still Gas.—Still gas is a mixture of extremely low-temperature-boiling hydrocarbons produced during the distillation of crude oil and may be used as refinery fuel and/or as a petrochemical feedstock. During 1974, refineries used 175,724,000 barrels of still gas as fuel, a nominal decrease from the 176,758,000 barrels consumed in 1973.[8] Consumption of still gas as a petrochemical feedstock increased 15.6% to 14,375,000 barrels from 12,428,000 barrels in 1973 and the uptrend continued in 1975.

Special Naphthas.—Special naphthas are used primarily as paint thinners, cleaning agents, and solvents. In 1974, as shown in table 36 domestic demand was 31,976,000 barrels, a shade below the 32,230,000 barrels in 1973 and the decline became even more pronounced in 1975.

Lubricants.—Domestic demand for lubricants declined about 4% to about 56.7 million barrels as shown in table 37 in 1974; so did total demand, as exports dropped to 11,936,000 barrels, 6% below shipments abroad in 1973. Lubricating oils accounted for nearly 98% of lubricant exports; greases accounted for the remainder. Part of the decline in demand reflected the decline in industrial activity. Industrial uses for lubricating oils and greases were slightly above the volumes for automotive and aviation use.

Waxes.—Demand for waxes slackened in 1974 to 6,801,000 bpd a decline of 2.8% from the 6,941,000 bpd of 1973, as indicated in table 38. The economic recession and the decline in business is reflected in weak wax demand. Paper converting accounts for 50% of wax end use.

Petroleum Coke.—Petroleum coke is reported by the Bureau of Mines as catalyst coke and marketable coke. Catalyst coke is a noncommercial coke; it cannot be recovered and marketed because it forms on the catalyst during the catalytic cracking of charging stock in the cracking unit of a refinery. This carbon is burned off the catalyst in the regenerator section of a cracking unit, and the coke is used as a refinery fuel without ever being seen. Marketable petroleum coke is the final "bottom-of-the-barrel" product of the oil refinery process. Marketable coke may be raw or green coke, or it may be calcined; that is, put through a roasting process in the presence of a flame to drive out the volatile impurities. There are three main outlets for marketable petroleum cokes: (1) Use as fuel, (2) manufacture of carbon products such as electrodes for metallurgical furnaces and silicon carbide abrasives, and (3) export.

Petroleum coke production totaled 123,746,000 barrels in 1974, a 6.4% decrease from that of 1973. Nearly 52%, or 63,950,000 barrels was marketable coke, as shown in table 39. Exports of marketable coke, rose almost 18% to 41,244,000 barrels. Nearly 30% of exports (12,344,000 barrels) went to Japan, an increase of 34% over the 9,197,000 shipped in 1973. Canada participated in the increase, receiving 5,185,000 barrels, a 25% increase. Conversely, exports to Europe were 9.6% lower; shipments to Belgium, Italy, the United Kingdom, and West Germany decreased. Volumewise, petroleum coke is our largest petroleum product export (table 59); it accounted for 51% of the 80,491,000 barrels exported in 1974.

Asphalt and Road Oil.—As a result of a slackening in road construction and building activity, asphalt and asphaltic products shipments in the United States in 1974 declined 7% from 34.3 million tons (5.5 barrels=1 short ton) to 31.8 million tons.

Shipments of petroleum asphalt paving products were 25.4 million tons, 1.7 million tons below those of 1973, as shown in table 40. Likewise, shipments of asphalt roofing products declined 11% from 5.7 million tons. Production of asphalt also declined moderately from 30.5 million to 29.9 million tons. With demand down, stocks rose slightly in 1974 (table 41).

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[7] U.S. Code of Federal Regulations. Federal Energy Guidelines, Part 211, Subpart 211.61. Federal Energy Administration, Washington, D.C.

[8] U.S. Bureau of Mines. Crude Petroleum, Petroleum Products, and Natural Gas Liquids. Mineral Industry Survey, April 1975 issue, released Aug. 8, 1975, 30 pp.

Shipments of road oil in 1974 totaled 1,251,091 tons, or 12% less than in 1973, as shown in table 42. Production declined slightly, but with demand reduced, inventories were restored in 1974. Trends in demand for asphalt and road oil over 1970–74 are indicated in table 40. Comparisons for 1973 and 1974 are also shown in tables 41 and 42 and are presented in the Bureau of Mines Mineral Industry Survey.[9]

Miscellaneous Finished Oils.—The petroleum industry produces a variety of miscellaneous products that are sold directly to consumers or in bulk to specialty companies, which package and distribute them under various trade names. Included in this category would be absorption oils, specialty oils such as hydraulic and insulating oils, medicinal oils, rust preventives, sand face, spray oils, and others. Also, SNG feedstock is included in this grouping. Production aggregated 25,246,000 barrels, a 27% gain over that of 1973. Most of the increase was in the petrochemicals category, as indicated in table 43.

Unfinished Oils.—Unfinished oils are oils that have been partly refined and will be further processed by refiners; examples are unfinished naphtha, gas oil, virgin- or straight-run naphtha, topped crude, cracking stock, etc. The rerun (net of unfinished oils) represents the receipts of domestic or foreign oil plus or minus changes in stocks.

TRANSPORTATION AND DISTRIBUTION

CRUDE OIL

A transportation system comprised of pipelines, tankers, barges, tank cars and, to a lesser degree, tank trucks move crude petroleum to refineries for processing. Refineries received 70.4% of their crude oil requirements by pipeline, 27.9% by water, and 1.7% by tank cars and trucks in 1974.

The 17 States comprising PAD district I accounted for 37.1% of domestic product demand. However, refineries in district I supplied only 17% of that demand. Foreign crude oil made up the lion's share, 83% of refinery input in district I; 14% came from other districts, and 3% came from within the district.

Tankers and barge movements of crude oil and petroleum products from the gulf coast to the east coast is shown in table 46.

Refined products produced at refineries in PAD district V in 1974 represented 90% of the domestic product demand for that district. Crude oil produced in district V supplied 57% of refinery input, foreign crude oil supplied 41%, and 2% was received from other PAD districts.

Data collected on receipts of domestic and foreign crude petroleum at refineries in the United States show receipts from local production (intrastate), receipts from other States (interstate), and receipts of imported crude. These data, by method of transportation, indicate the final receipts by water, pipeline, tank car, and truck. Receipts of domestic crude by water usually are moved by pipeline from the point of production to the point of water shipment.

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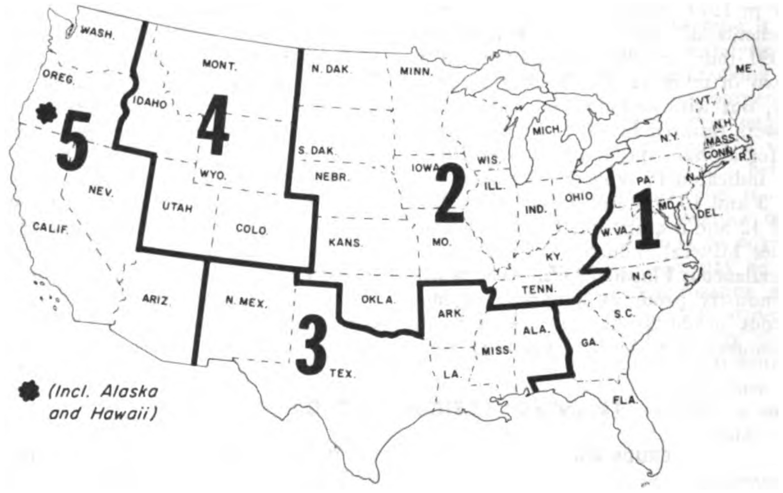
[9] U.S. Bureau of Mines. Sales of Asphalt in 1974. Mineral Industry Survey, Sept. 30, 1975, 6 pp.

PETROLEUM ADMINISTRATION FOR DEFENSE (PAD) DISTRICTS



BUREAU OF MINES REFINING DISTRICTS

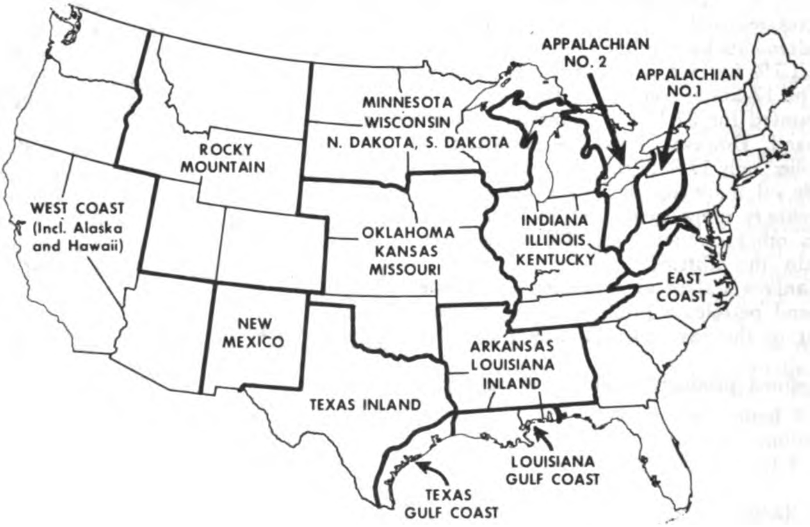


Figure 5.—Maps of Petroleum Administration for Defense (PAD) districts and Bureau of Mines refining districts.

Refinery receipts of crude oil carried by tankers and barges totaled 1,238 million barrels, or nearly 3.4 million bpd, in 1974. In 1973, 1,174.0 million barrels, or 3.2 million bpd, were received by refineries. About 896 million barrels (2,455,200 bpd) represented refinery receipts of foreign crude in 1974; the comparable figure in 1973 was 775 million barrels, or 2,124,200 bpd. A 5 year series of receipts is shown in table 44, interdistrict movements by tanker and barge are provided by tables 45 and 46.

REFINED PRODUCTS

Domestic demand for petroleum products averaged 16.6 million bpd in 1974, a 3.9% drop from the 17.3 million bpd of 1973. Demand in 1974 is broken down by PAD districts in table 14.

PIPELINES

The Bureau of Mines triennial pipeline survey of January 1, 1974, reported that pipeline mileage on that date totaled 222,355 compared with 218,671 miles as of January 1, 1971. Crude oil trunklines accounted for 76,250 miles, which is a nominal increase over the mileage reported as of January 1, 1971. Crude oil gathering lines mileage continued to decline, dropping 2.6% to a January 1, 1974, level of 69,260 miles; mileage had reached a peak of 76,988 in 1962. Capacity of crude oil trunklines increased to 71,159,000 barrels, a slight gain over that of 1971. However, product lines capacity increased 15% to 48,775,000 barrels. Part of this increase resulted from replacement of existing lines with larger diameter pipe; part represented new mileage. It is estimated that 598 miles of crude oil lines were laid in 1973 compared with 361 miles in 1972.

Crude oil pipelines delivered 3,124.6 million barrels or 8,560,000 bpd to refineries in 1974, a decrease of 5.7% from the 9,078,000 bpd in 1973 (table 44). Petroleum product pipelines delivered 3,204.9 million barrels, or an average of 8,780,000 bpd in 1973, compared with 2,967.9 million barrels, or 8,109,000 bpd, in 1972. Transportation by pipeline of petroleum products between PAD districts is shown in table 47. Transportation and stocks in lines and working tanks is available in table 48; tariff rates, table 49.

RAIL, TANK TRUCK, BARGE AND TANKERS

The annual survey of the Association of Oil pipelines estimated that the total tonnage of crude oil and petroleum products carried was 1.9 billion tons in 1973. Of this total, 47.44% was transported by pipelines, 21.90% by water carriers, 29.11% by motor carriers, and 1.55% by railroads. On an overall basis, volumes transported in 1973 were 4% greater than those in 1972. Petroleum products accounted for 66% of the volume transported.

Product pipelines transport only the light products such as gasoline, light fuel oils, and heating oils, LPG, kerosine, and jet fuel. These lines transported 1,282,527,200 tons, or 32.74%, of the total. Motor carriers transported 504,177,000, or 39.31%, of the petroleum products carried. In terms of billions of ton miles, the total aggregated 478.0, of which 42.9% was transported by pipelines, 49.8% by water carriers, 4.9% by motor carriers, and 2.4% by railroads. Total crude petroleum carried in domestic transportation, in billions of ton miles, was 362.9 in 1973. Pipelines accounted for 83.2% and water carriers for 16.2%.

Deepwater Ports.—Many of the tankers in use today are very large crude carriers (VLCC's) and virtually all of these ships are unable to enter ports with a depth under 75 feet. At the present time, there are no ports in the United States capable of accommodating VLCC's with capacities greater than 200,000 deadweight tons. The deepest ports in the United States are located on the west coast and can handle only tankers up to 150,000 deadweight tons. Most harbors in the United States are limited to smaller ships with capacities ranging from 40,000 to 70,000 deadweight tons. Hence, the need for deepwater ports has become imperative.

The Deepwater Port Act of 1974, signed by the President, provided for licensing and regulation of deepwater ports. The Secretary of Transportation is empowered to grant licenses for ownership, construction, and operation of deepwater-port facilities. At the same time, a Governor of an adjacent coastal State located within 15 miles of a deepwater port or connected directly by pipeline, to a deepwater port could veto the project.

Two corporations, formed by groups of companies, are planning to construct two such ports: One off the Louisiana coast in water over 100 feet deep in the Gulf of Mexico, and the other off the Texas coast. In the Louisiana Offshore Oil Port (LOOP), the corporation proposes to store imported oil in the Clovelly salt dome near Galliano, La. The proposed storage capacity of this facility is expected to be about 56 million barrels of oil.

TANKER RATES

Tanker charter rates, after reaching a peak late in 1973, have been in a downtrend. From $2.02 per barrel, charters in December 1973 for 34 degree crude oil for Large Range 2 tankers (from 80,000 to 159,999 deadweight tons (dwt)) dropped nearly 40% by December 1974 to $1.21 per barrel, for cargoes destined from Ras Tanura to New York via the Cape of Good Hope. Charters, same destination, for vessels of 16,000 to 24,999 dwt, which are classified as "General Purpose" tankers, dropped over the same 1973-74 interval from $3.23 per barrel to $2.63 per barrel.

This softening in rates is readily understandable. Consumer resistance to higher prices for crude oil and products, a mild winter, intensive conservation programs, and the economic recession resulted in a 3.6% drop in 1974 demand. Moreover, an oversaturation in tanker supply has helped to weaken tanker rates and there was little evidence of a change in that situation in 1975. It should be noted, however, that average tanker charter rates move slowly since they include charters, which run about 3 years. Also, much of the shipping moves in company-owned vessels.

STOCKS

Stocks of all oils have been increasing steadily after touching a low point of 866.9 million barrels in February 1973. This was the lowest inventory position since February 1968, and close to stock levels during the 1967 Arab-Israeli conflict, which cut off imports from the Mideast. By the end of 1974, stocks of all oils had recovered to 1,073.6 million barrels, an increase of 65.3 million barrels over the inventory position at the end of 1973 as shown in table 50. Stocks of refined products were 36.2 million barrels higher at yearend 1974. Crude oil stocks, which shrank from 279.5 million barrels in May 1972 to a 7-year low of 235.4 million barrels in February 1973, recovered at least in part to 265 million barrels by the end of 1974 as imports increased. The stock position continued to strengthen in 1975.

PRICES

Crude Oil.—The increase of the host countries shares in oil participations from 25% to 60%, the embargo of oil shipments to the United States by Arab nations, and the sharp increases in prices adopted by the Organization of Petroleum Exporting Countries (OPEC) have all contributed to the price increases that caused consternation in the oil-consuming nations throughout the world in 1973 and into 1974. The uptrend continued in 1974, but with economic recession worldwide and crude oil a glut on world markets, the climb in prices had been arrested as of mid-1975.

By way of background, a large part of crude oil obtained from foreign countries was equity oil; that is, oil produced and owned by companies that had obtained concessions from host countries and/or governments. In return, the companies were required to pay both a royalty and tax for oil produced. The aggregate of tax royalty and the cost to produce oil represented the total cost of equity oil and was termed "tax-paid cost." The royalty and tax were based on a posted price that was initially established by negotiations between the host country and the oil-producing company. More recently, however, the host government alone establishes the posted price.

In January 1973, Saudi Arabia, the United Arab Emirates, and Qatar adopted participation agreements which gave those governments 25% ownership of the oil produced in their respective countries. This 25% segment was known as "participation oil" and most of this oil was sold back to the producing companies at "buyback prices." As a result, oil prices rose as the higher priced "buyback" oil was averaged in with equity oil. Subsequently, the host governments increased their participation from 25% to 60%. Some countries also raised the tax rate and the royalty.

Prices continued to rise in 1974, and the uptrend continued into 1975. The posted price for Arabian light crude oil as of January 1974 was $11.65 per barrel. This price was equivalent to an average equity and buyback cost of $9.27 per barrel.

On the domestic scene, the average price of crude oil at the wellhead, which was $3.39 per barrel in 1971, held at that level through 1972. However, in March 1973, the Cost of Living Council (CLC) granted an increase of $0.25 per barrel, lifting the price to $3.64 per barrel. On May 15, 1973, the CLC allowed another $0.35 increase. Under phase 4 petroleum regulations, the ceiling price for crude oil was the posted price in each U.S. oilfield plus $0.35 per barrel. The average value per barrel at wells was $6.74, or 73% above the $3.89 per barrel of 1973, as shown in table 55.

On August 17, 1973, in an effort to stimulate production of domestic crude oil, the CLC enacted a two-tier pricing system under phase 4 oil regulations. The system released from ceiling prices "new oil" (oil produced above 1972 levels) and made an adjustment for the remainder of current production. The price of new oil produced, which was not covered by the price ceiling, rose steadily to market levels. The ceiling price for domestic crude was about $1 per barrel below the world price at the time phase 4 rules were issued on August 17. Since then, however, world prices have increased sharply and so have prices for new or exempt oil; that is, oil exempt from price controls. What constituted exempt oil was broadened as of November 16, 1973, when the CLC exempted prices charged for the first sale of crude petroleum and petroleum condensates, including natural gas liquids produced from any stripper-well lease. A "stripper-well lease" was defined as a property whose average daily production of crude petroleum, condensates, etc., did not exceed 10 bpd during the preceding calendar month.

The price-regulating function of CLC was absorbed by FEA in March 1974, and FEA took over this work in May 1974.

Between September and the end of December 1973, the price of new or exempt oil rose from $5.12 to $9.51 per barrel. Between January 1974 and December 1974, the price per barrel rose 13% from $9.82 or $11.08. The price of old or controlled oil rose nearly 35% from $3.90 per barrel in August 1973 to $5.25 in December. The $5.25 price prevailed through 1974 and carried over into 1975.

In spite of price controls, petroleum prices have climbed steadily and so have prices refiners must pay for crude oil, both domestic and foreign (refiner's acquisition costs). The following tabulation shows refiner's acquisition cost per barrel for imported oil, domestic oil, and a composite of both, as maintained by FEA:

	Domestic	Imported	Composite
1973:			
May	$3.82	$3.92	$3.85
November	5.00	6.49	5.45
December	5.95	8.22	6.54
1974:			
January	6.72	9.59	7.46
April	7.21	12.72	9.18
July	7.19	12.75	9.30
October	7.26	12.44	9.22
December	7.39	12.82	9.28
1975:			
January	7.78	12.77	9.48
April	8.23	13.26	9.83
May	8.33	13.27	9.79
June	[1] 8.33	14.15	[1] 10.23

[1] Preliminary.

As shown in the tabulation, a composite of refiners' acquisition costs of imported and domestic crude was $3.85 per barrel in May 1973. By April 1975, the price was $9.83 per barrel, or more than 2½ times greater. The rise was due primarily to the increase in the cost of imported oil. The refiner's acquisition cost for imported oil rose from $3.92 per barrel in May 1973 to $13.26 per barrel by March 1975, better than a threefold increase.

Likewise, the price of domestic oil climbed steadily after enactment of the two-tier price system.

Entitlements.—Subsequent to adoption of the two-tier pricing system, FEA in November 1974 initiated the entitlements system under the Old Oil Allocation Program (CFR 211.67). Every refiner had to have an entitlement to process a barrel of old crude oil as a percentage of total crude processed (that is, the total runs to stills) of old oil, imported oil, and domestic exempted oil. Each month, FEA calculates the amount of old oil produced as a percentage of total crude oil processed. If, for example, the old-oil ratio was 40% and a refiner's old-oil ratio was 60%, this refiner would have to buy entitlements equal to 20% at prices set by FEA from those refiners with less than 40%. An entitlement purchased at $5.00 would entitle the purchaser to process 1 barrel of old oil at about $5.25 per barrel, so that the effective cost would be about $10.25 per barrel for the 20% over the old-oil ratio.

Refined Products.—Price controls on refined products were eased under phase 4 to permit refiners to pass through at least part of the increased costs. These refiner's acquisition costs are ultimately passed through to the consumer in higher prices for petroleum products such as gasoline, home-heating fuel oil, and diesel fuels. Data on prices of selected crude oils and products are available in tables 56–58.

In the United States, gasoline outweighs all other products in terms of volume produced and relative importance in the refinery mix. Prices of gasoline in 1973 did not begin to rise until after OPEC action on crude oil in October 1973, but from then on the climb was rapid. The average service station price of regular-grade gasoline (including taxes) was 38.71 cents per gallon as of September 1, 1973. By December 1, the price had risen to 42.26 cents. Prices have continued upward. By December 1, 1974, the price was 53.15 cents, according to Platt's Oil Price Handbook and Oilmanac 1974.

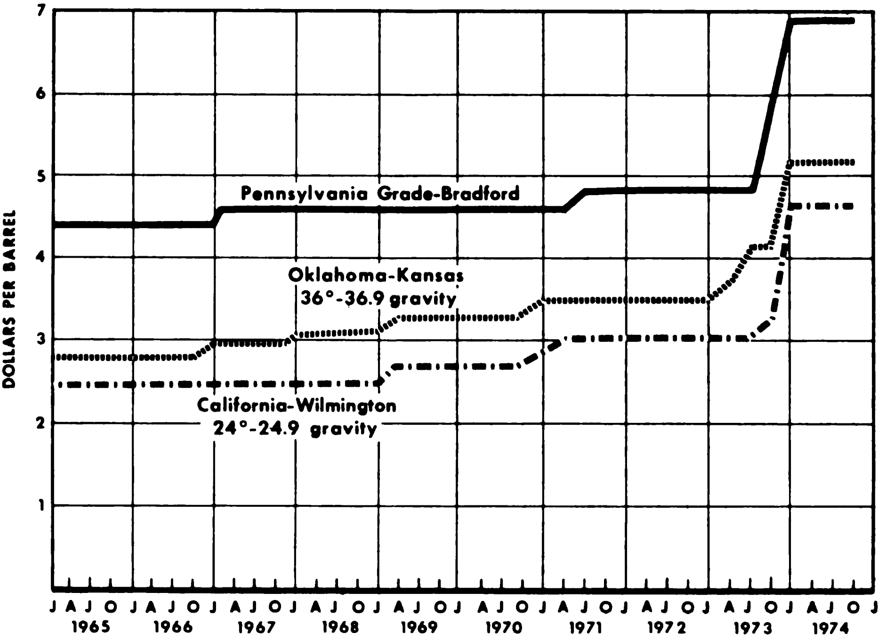


Figure 6.—Posted prices of selected grades of crude petroleum.

Shown in the following tabulation (in dollars per 100 gallons) are some comparisons in selected cities of prices of No. 2 home-heating oil between 1972 and January 1975. These intervals indicate the impact of the pass-through policy on retail prices. Between January 1974 and January 1975, the U.S. average rose 15%.

Standard metropolitan statistical areas	December 1972	December 1973	January 1974	January 1975
U.S. average	$19.72	$22.75	$32.89	$37.84
Baltimore	19.33	26.64	31.18	36.60
Boston	20.40	30.44	32.90	40.06
Chicago and Northwestern Indiana	18.66	27.01	31.66	38.96
Detroit	18.62	25.14	30.35	35.76
Milwaukee	18.93	27.85	31.23	36.58
Minneapolis-St. Paul	18.06	26.42	34.74	35.72
New York and Northeastern New Jersey	20.40	33.41	36.90	40.04
Philadelphia	19.23	26.27	31.30	37.96
St. Louis	19.49	26.53	33.72	37.51
Washington, D.C	19.78	29.95	33.30	40.82
Seattle	22.17	27.28	33.50	38.20

Source: Bureau of Labor Statistics.

Residual Fuel Oil Prices.—The price of Bunker "C" fuel oil at New York Harbor was depressed throughout 1972, but demand for tankers quickened and fuel oil prices stiffened. From $3.45 per barrel at the end of 1972, prices for Bunker "C" climbed steadily to $5.42 per barrel by December 1973. By December 1974, the price had more than doubled to $11.09 per barrel. The trend of Bunker "C" prices for 1964–74 inclusive, is shown in figure 7.

Unlike Bunker "C" fuel, use of No. 6 residual fuel oil is restricted to 0.3% sulfur in many communities along the eastern seaboard. New York City is an example. The average price per barrel for No. 6 fuel oil in New York Harbor market since 1971 was as follows:

1971	$4.87
1972	4.66
1973	5.99
1974	14.11
1975 (January 2)	12.55

The softening in the January 1975 price reflects, in part, the mild winter and the decline in business activity.

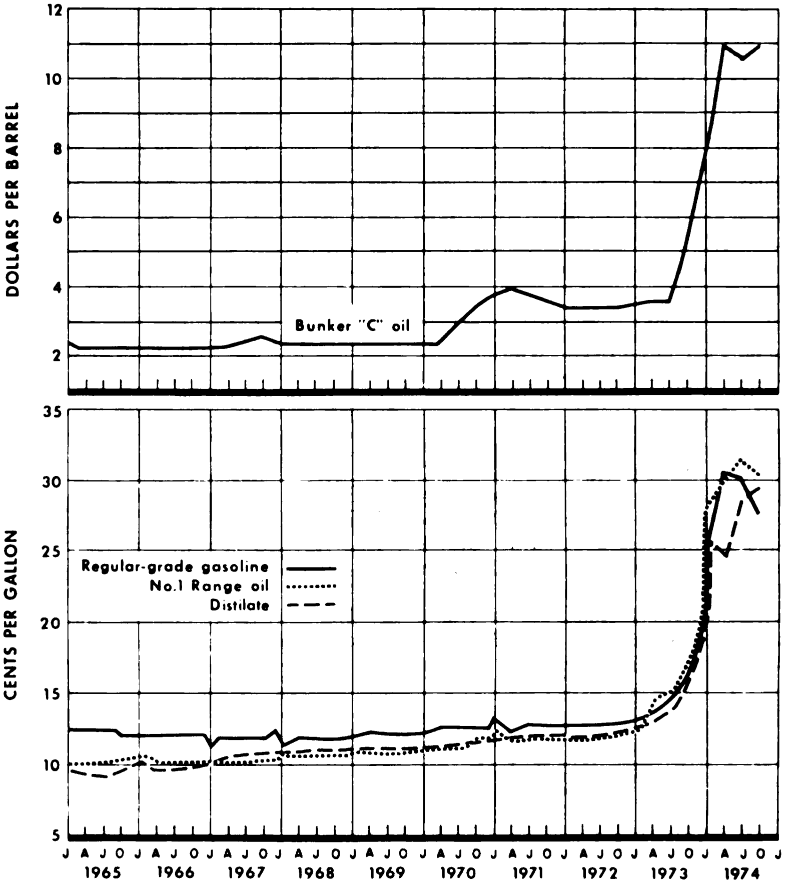


Figure 7.—Quarterly prices of Bunker "C" and No. 2 distillate fuel at New York Harbor, No. 1 range oil at Chicago district, and regular-grade gasoline at refineries in Oklahoma.

FOREIGN TRADE

Exports.—Exports of refined products and crude oil in 1974 were down 3.9 million barrels; the 6.3-million-barrel increase in petroleum coke exports was more than offset by declines in exports of distillate, petrochemical feedstocks, gasoline, lubricating oil, naphtha, and jet fuel. Coke accounted for 51% of exports. Japan overshadowed all other countries in accounting for 12.3 million barrels, or 30%, of petroleum coke sales in terms of volume. Canada was second in importance with 12.6%. Exports by product and destination in 1973 and 1974 are shown in table 60.

Imports.—Imports of crude oil and refined products aggregated 2,222.2 million barrels, or 6.1 million bpd, in 1974, a decrease of 2.7%. An increase in crude imports failed to offset the 13% drop in imports of products. The Arab oil embargo ended toward the end of the 1974 first quarter, and by yearend, crude imports totaled 1,269 million barrels or 3.48 million bpd, 7% over 1973 imports as shown in table 61. The sharpest increases in imports were from Iran, Nigeria, and Indonesia. As a result of Canada's planned cutback in crude oil exports to the United

States, imports from that country fell from 1 million bpd to about 791,000 bpd. Despite these cutbacks, more oil was imported from Canada in 1974 than any other country as shown in table 62.

Nigeria was the second largest supplier of crude oil to the United States. Imports from that country averaged nearly 697,000 bpd in 1974, a 55% increase over the amount received in 1973. Imports from Africa in 1974 were nearly as large as those from the Middle East.

Imports of refined products in 1974 aggregated 2.6 million bpd, 13% less than the 3.0 million bpd in 1973. Most of the decrease was in residual fuel oil, distillate fuel oil, and kerosine-type jet fuel; imports were lower by 433,000 bpd. Gasoline imports were 25.6 million barrels, or 52.6%, higher than in 1973. Most of these increases originated in Europe, South America, and Central America. Comparisons of imports in 1974 and 1973 by country and product are shown in table 62.

Included in the totals for imports of refined products were 1,783,000 barrels of naphtha-type jet fuel, 32,701,000 barrels of kerosine-type jet fuel, 3,967,000 barrels of distillate, and 34,710,000 barrels of residual fuel oil, all of which were withdrawn from bond for use as fuel for aircraft and vessels engaged in overseas commerce. These imports were exempted from tariff duties. Residual fuel oil imported by the military for offshore use in 1974 totaled 2,879,000 barrels, 14% less than the volume used in 1973.

NATIVE ASPHALT

Bituminous Limestone, Sandstone, and Gilsonite.—Natural rock asphalt and limestone rock asphalt were produced in Alabama, Missouri, and Texas, and were used for road-building material. Gilsonite was produced in Utah. The total production of native asphalts and related bitumens in 1974 was 2,021,165 tons with a value of $16,666,000.

WORLD REVIEW

The petroleum production cutbacks and the embargoes against deliveries to select market-economy nations adopted as a political weapon by Arab interests at the outbreak of Arab-Israeli hostilities, had been relaxed and eventually withdrawn by the spring of 1974. However, the fourfold increase in the price of Arabian light "marker" crude at $11.65 per barrel, effected by the 13 member nations of OPEC resulted in economic crisis in the major industrial countries as higher costs further inflated economies and stagnated industries. Developing nations were equally threatened since their foreign exchange reserves could not absorb higher energy prices, which placed their economic development in jeopardy. Participation agreements between state-owned companies and foreign operations increased in favor of the state. Nationalization of petroleum operations was realized in Algeria, Iraq, Iran, Libya, and Nigeria and was pending in Kuwait, Venezuela and Saudi Arabia. Both these factors disrupted normal trading relations and traditional supply sources, adding to the mounting problems of oil-consuming nations.

In mid-November, the International Energy Agency, representing 17 oil-consuming nations, was formed to share energy resources in the event of another embargo and to promote international cooperation in the development of alternative energy sources. In 1974, imported petroleum accounted for more than 60% of the primary energy source of Western Europe, 80% of the primary energy source of Japan, and nearly 17% of the primary energy source of the United States. The development of alternative energy sources for major oil importing areas had met with little progress by yearend, principally because of the vast expenditures required to launch such a program. Alternative energy expenditures that may be justified at a marker price of $11.65 per barrel of imported oil may not be justified if the price of imported oil is reduced. Because the current posted price expresses between 50 to 100 times the actual cost of producing Middle East oil, price reductions in a competitive market are a possible threat to high-cost alternative-energy development. However, this possibility appears remote in light of the mid-November OPEC meeting in Vienna advocating even higher prices for imported oil.

Production.—World crude oil production in 1974 averaged 56.3 million bpd, including an estimated 9.0 million bpd recovered from offshore operations. Production results for 1974 reflected an increase of less than 1% over that of 1973. This represented a sharp decline in the 7% to 10% annual growth rate historically achieved in the production of petroleum, as shown in table 63. During the year, ranking producers were realigned, bringing the U.S.S.R. to first position in crude oil production, followed by the United States, Saudi Arabia, and Iran.

Substantial production increases above 1973 production levels were reported by the following countries: Saudi Arabia, nearly 885,000 bpd; the U.S.S.R., approximately 765,000 bpd; and the People's Republic of China, averaging about 300,000 bpd. These increases were largely counterbalanced by significant production declines in the following countries: Libya, more than 650,000 bpd; Kuwait, nearly 475,000 bpd; the United States, nearly 435,000 bpd; and Venezuela, nearly 390,000 bpd.

Crude oil production by member nations of OPEC declined more than 300,000 bpd from 1973 production levels; however, the 13 nations constituting the OPEC group continued to account for about 55% of total world crude oil production. Production declines registered by the North African and South American member nations were largely offset by increased production from member nations in the Middle East. Member nations of OPEC in the Middle East are Saudi Arabia, Iran, Kuwait, Iraq, United Arab Emirates, and Qatar. Combined production from these members totaled nearly 21.2 million bpd compared with 20.6 million bpd in 1973.

Crude Oil Movements.—During 1974, crude oil movements to the major consuming centers of Western Europe, Japan, and the United States totaled nearly 22 million bpd; the Middle East supplied 65% of the total (figure 8). Approximately 13.7 million bpd was imported by Western Europe, which represented a decline of nearly 1 million bpd from the 1973 import levels (when prices were lower).

Japanese crude oil imports averaged 4.8 million bpd, a decline of 100,000 bpd from that of 1973. Although imports from the Middle East supplied 77% of Japanese total crude oil imports in 1974, the flow of Middle East crude was reduced by 125,000 bpd, compared with 1973 imports. However, Japanese crude imports from the People's Republic of China have nearly quadrupled in this period.

The United States imported nearly 3.5 million bpd of crude oil. Canada supplied nearly 791,000 bpd; Nigeria supplied nearly 700,000 bpd; Iran 463,000 and Saudi Arabia supplied about 438,000 bpd.

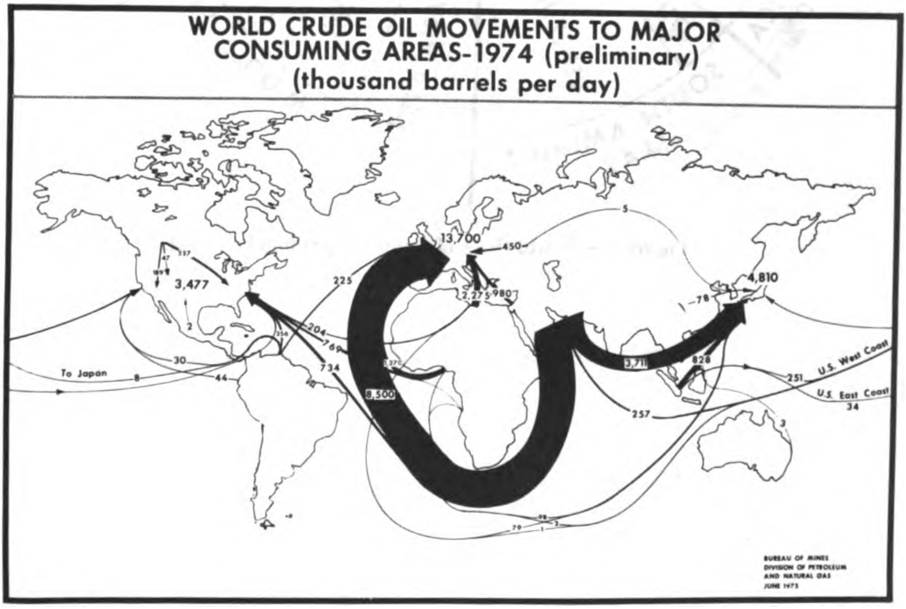


Figure 8.—World crude oil movements to major consuming areas, 1974.

1964 - 10.3 BILLION BARRELS

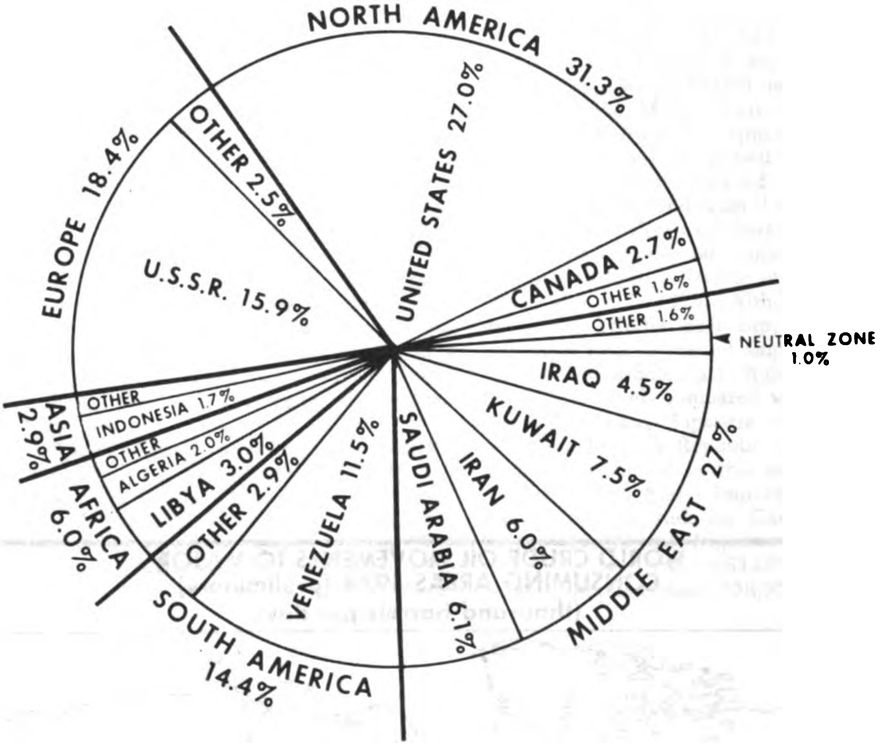


Figure 9.—World share of crude oil production, 1964.

1974 - 20.5 BILLION BARRELS

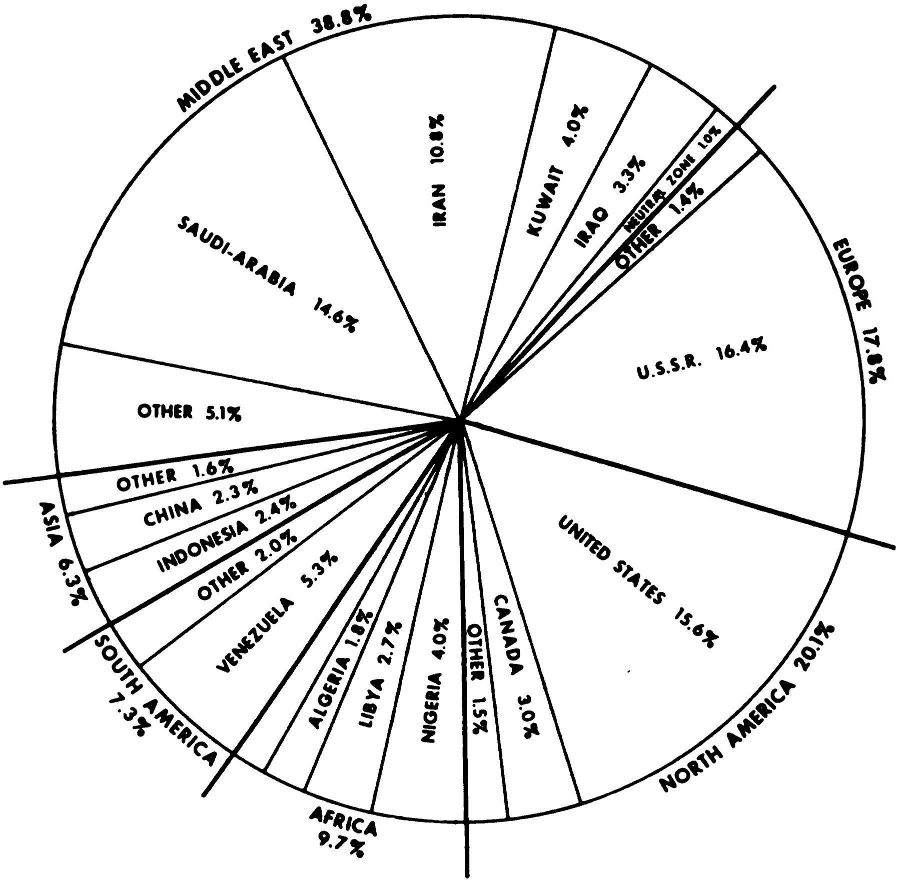


Figure 10.—World share of crude oil production, 1974.

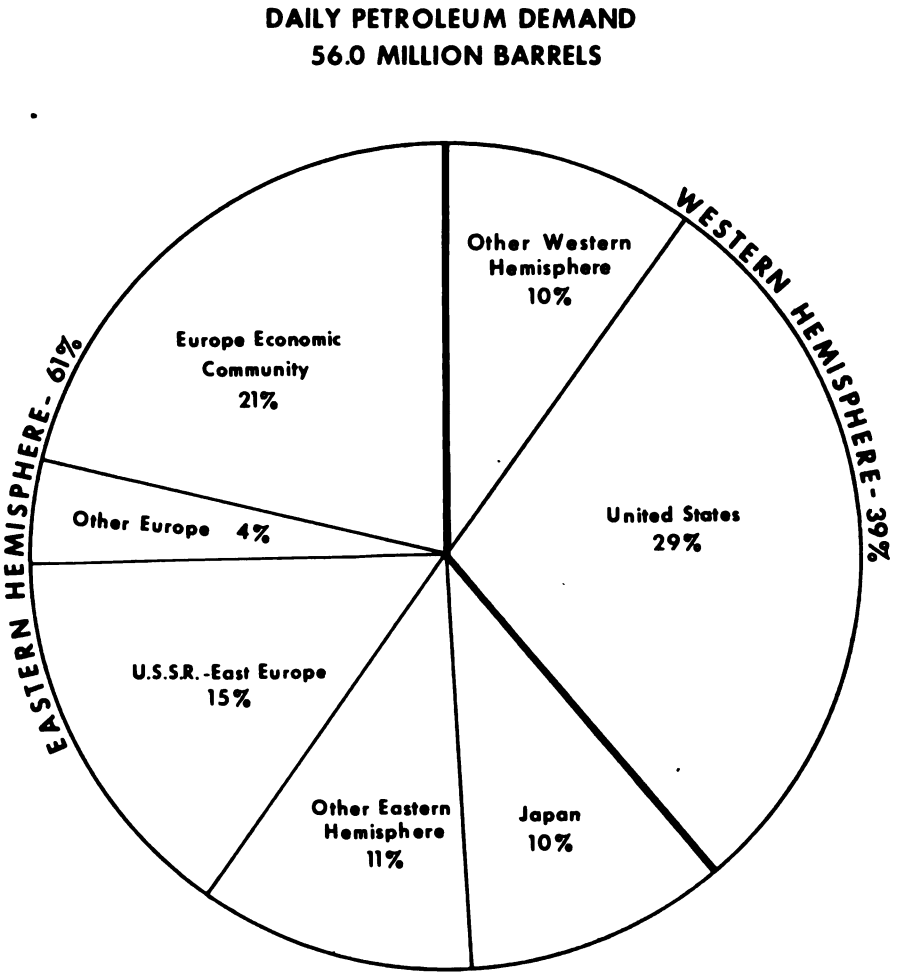


Figure 11.—World daily petroleum demand, 1974.

Transportation.—Excluding about 42 million dwt in combined carriers, the world tanker fleet at yearend 1974 totaled 260 million dwt, an increase of 40 million dwt over that of 1973. The decline in world petroleum consumption with the resulting drop in demand for tanker transportation created a tanker surplus nearly equivalent to the additional capacity added in 1974.

About 30% of total tanker tonnage sails under the Liberian flag, followed by registries in the United Kingdom and Japan, which account for 13% and 11%, respectively. Tankers between 200,000- and 285,000-dwt capacity constitute more than 40% of the total tanker fleet. Most of the additional tanker capacity available in 1974 was in this category.

Voyages from the Middle East occupied an estimated 77% of the oceangoing fleet. Although voyages from the Middle East to Europe and Japan were slightly reduced, they continued to occupy nearly 60% of the total oceangoing fleet.

At yearend, vessels carrying LPG numbered 431, with a total carrying capacity of 4 million cubic meters, or nearly 141.3 million cubic feet.

Refining Capacity.—Total world crude oil refining capacity at yearend was estimated at 65.5 million bpd, an increase of less than 1 million bpd over 1973 capacity levels. The Eastern Hemisphere, containing the major refining centers of Western Europe, the U.S.S.R., and Japan, accounted for 64% of total world refining capacity, or approximately 42 million bpd. Currently scheduled expansion and construction programs should increase world refining capacity to an estimated 90 million bpd by 1978; however, reduced consumption trends may require reappraisal of refinery expansion plans, particularly in Western Europe and Japan.

Consumption.—World petroleum consumption declined to an estimated level of 55.4 million bpd in 1974 as a result of the fourfold increase in petroleum pricing. Consumption levels in major industrial areas were markedly reduced. Western European consumption was reduced by well over 1 million bpd. Japanese consumption was reduced by 120,000 bpd.

Algeria.—Crude reserves were estimated at nearly 8 billion barrels. To augment these reserves, the state-owned company Société Nationale pour la Recherche, la Production, le Transport, la Transformation, et la Commercialisation des Hydrocarbures (SONATRACH) has engaged in multiple exploration agreements with leading French, West German, Spanish, and United States firms. During the year, at least nine firms entered 49% to 51% joint venture arrangements with SONATRACH. Foreign exploration partners bear exploration costs and, in the event of discovery, SONATRACH reimburses up to 15% of exploration costs and assumes 51% of all development cost.

Economic development plans include expansion of petroleum production from 1 million bpd in 1974 to 1.5 million bpd in 1980, and the expansion of refining capacity from 115,000 bpd to 600,000 bpd in the same time period.

The Italian firm Società Nazionale Metanodotti Progetti S.p.A. (SNAM) is construction contractor for a 300,000-bpd-capacity refinery at Skikda. The refinery yield will serve both the export market and the Algerian petrochemical industry.

Argentina.—By a July decree, the state-owned Yacimientos Petrolíferos Fiscales (YPF) took over control of marketing operations of Esso Corp., Cities Service Co., Royal Dutch/Shell, and four smaller companies, thus controlling all gasoline sales in the country. During the year, the Argentinian congress was deliberating on the hydrocarbons law, which affords YPF control over all petroleum operations in the country. Production in 1974 averaged 414,000 bpd. Domestic and imported crude oils (principally from Libya) were refined in 14 refineries with a combined capacity of 720,000 bpd. Petroleum consumption was estimated at 500,000 bpd; more than 25% was derived from imported crude oil and products.

A 32-inch-diameter, 240,000-bpd-capacity pipeline was completed between Puerto Rosales and the 290,000-bpd-capacity La Plata refinery, cutting the cost of crude oil delivered via waters too shallow to accommodate large tankers.

Australia.—Legislation placing control of the petroleum industry under the Federal Government was under review by the High Court. Two laws were under review: The Petroleum and Minerals Authority Act, which establishes a Government agency for exploration, production and marketing petroleum; and the Seas and Submerged Lands Act, which transfers jurisdiction over offshore operations from States to the Federal Government. Approximately 115,-

800 square miles of exploration leases will expire or come up for renewal in 1974–75. The Government has announced its intention to take over these leases, eventually maintaining at least 50% equity with private operating groups.

Offshore operations in the Bass Strait yielded an average of nearly 360,000 bpd of crude oil, accounting for the bulk of Australia's production. The Mackerel field, with reserves of 200 million barrels, and the Tuna field, with reserves of 84 million barrels, will enter the Bass Strait production network in 1977 and 1978 respectively.

Austria.—Austrian production averaged nearly 43,000 bpd. The Austrian national company, Österreichische Mineral-ölverwaltung A.G. (ÖMV), accounted for the bulk of output, producing 38,000 bpd. Domestic and imported crude is refined at the 220,000-bpd-capacity ÖMV Schwechat refinery. Consumption of petroleum products was reported at 210,000 bpd, a 10.2% reduction from consumption levels in 1973 and a reversal of the 9.3% annual average rate of increase experienced in 1969–73. Major consumption declines were reported for lubricants, kerosine, special gasoline, distillate fuel oil, and residual fuels.

Bahamas.—Bahamas Oil Refining Co. at Freeport operated a 500,000-bpd-capacity refinery on imported crude oils. Construction of two additional refineries are under consideration; these include a 250,000 to 300,000-bpd-capacity refinery near Pelican Point, and a 125,000 to 250,000-bpd-capacity refinery on Grand Bahama Island.

Brazil.—Petroleum imports averaging 600,000 bpd satisfied about 80% of Brazil's petroleum consumption requirements. In 1974, petroleum imports placed a $3 billion drain in the national balance of payments position. In an effort to reduce the outflow of Brazilian capital, the state-owned Petróleo Brasileira S.A. (PETROBRAS) accelerated exploration activities along the continental shelf where at least three promising discoveries were reported in 1974. Most significant of these is the Garoupa field discovered just offshore of Rio de Janeiro. Probable reserve estimates are 600 million barrels of crude oil, testing at 31° API gravity with 0.14% sulfur content.

In addition to accelerated exploration and development activity, Brazil has awarded contracts to SNAM of Italy and the Japan Gasoline Co. to participate in refinery construction and expansion, which will raise refining capacity from 962,000 bpd in 1974 to 1.3 million bpd by 1978.

China, People's Republic of.—Output continued to climb, increasing 30% over 1973 output to a production level averaging 1.3 million bpd. Much of China's crude oil is derived from the north and northeast provinces, which include the Taching Field.

Refining capacity has historically balanced crude oil production capacity; however, recent drilling and field development have escalated China's crude oil production beyond refining capacity, and increased crude oil exports are anticipated for the immediate future. To facilitate crude oil exports, a pipeline connecting Taching Field with the Pohai Bay port of Dairen was under construction in 1974.

Indonesia.—Extensive exploration activity resulted in the addition of 5 billion barrels to Indonesia's petroleum reserves, raising the total to 15 billion barrels as of December 31, 1974. During the year, 231 exploratory wells were completed, resulting in 71 discovery wells and a success ratio of nearly 1:3. Major discoveries were reported by Phillips Petroleum Co. operating in the Teluk Berou area, by Atlantic Richfield Indonesia Ltd. operating in the Ardjuna area, by the Indonesian-American Oil Co. operating in the Java Sea (south of Sumatra), and by the Union Oil Co. operating in the Straits of Macassar (east of Kalimantan).

Crude production averaged 1.37 million bpd in 1974, a slight increase over the 1973 production level. During the first half of the year, production averaged 1.5 million bpd, but as a result of reduced demand, production declined to an average of 1.2 million bpd for the remainder of the year.

More than 75% of Indonesia's crude oil is exported, with Japan and the United States the principal markets. Although a member of OPEC, Indonesia prices crude oil above the Arabian light marker crude oil price. Indonesian light crude oil buyers pay a low-sulfur premium, and Pacific area buyers pay a freight differential on Indonesian crude oil. The sales price for 34° API gravity crude oil was $10.80 per barrel on January 1, 1974, was raised to $12.60 on July 1, and remained at that level through the year in spite of reduced demand.

Iran.—Production averaged more than 6 million bpd with the Marun, Agha Jari, Gachsaran, and Ahwaz fields each averaging nearly 1 million bpd or more. Iran anticipates production levels averaging 7.5 million bpd by 1977 as a result of a vast gas-injection program.

Iran exports well over 5 million barrels of crude oil per day. The economic advantage realized from the export of petroleum products has prompted Iran to engage in negotiations for construction of several export refineries of 500,000-bpd capacity. During 1974, negotiations centered on two proposed export refineries involving the partnership of the National Iranian Oil Co. (NIOC) with several West German interests in the construction of a 500,000-bpd-capacity refinery at Bushire, as well as a partnership involving NIOC and Royal Dutch/Shell in a second refinery of similar size at an undetermined location. No firm construction contracts for export refineries were announced by yearend.

Saudi Arabia.—Maintaining the position of third largest world producer of crude oil, Saudi Arabia produced an average of 8.5 million bpd of crude oil in 1974. More than 4.6 million barrels was produced from the Ghawar field, whereas the Safaniyah offshore field produced well over 1 million barrels, and the Berri offshore field produced nearly 0.9 million bpd.

The Saudi Arabian Government acquired 25% participation in the Arabian American Oil Co. (Aramco) in 1973. By 1974, Government participation was increased to 60%, with negotiations underway for a full Government takeover.

U.S.S.R.—Production of crude oil and field condensate averaged 9.2 million bpd, affording the U.S.S.R. the lead position among world crude oil producers. The 9% increase over 1973 production was largely attributed to development of the West Siberian fields, the largest of which is Samotlar, where production exceeded 1.2 million bpd in 1974. Total production from West Siberia reached 2.34 million bpd in 1974. Total Soviet crude production was expected to reach 9.8 million bpd by 1975. West Siberia will account for nearly one-third of the output, with the Samotlar field alone producing 1.8 million bpd.

Approximately 80 refineries with an estimated combined capacity of 7.3 million bpd were in operation in 1974.

Soviet exports of crude oil and petroleum products averaged nearly 2.4 million bpd. Crude oil constituted about 70% of all petroleum exports. The 48-inch-diameter Kuybyshev-Tikhoretsk-Novorossiysk crude oil pipeline was near completion by yearend. The pipeline will connect producing fields with the oil-loading ports of the Black Sea to facilitate exports.

United Kingdom.—Government legislation involving a petroleum revenue tax and 51% Government participation in petroleum operations in the British sector of the North Sea was debated throughout the year. Nationalization remained a possibility if a 51% Government participation was not made available by operating companies.

Three fields in the British sector of the North Sea were scheduled for production in 1975. Combined production from the Hamilton group's Argyll field, from the British Petroleum Forties field, and from the Royal Dutch/Shell and Esso Auk field was expected to total 150,000 bpd in 1975. British Government estimates place production from the North Sea from 2 to 2.8 million bpd by 1980.

Venezuela.—All phases of the petroleum industry were affected by the uncertainties fostered by impending nationalization. Foreign company investment expenditures for 1974 were projected at well over $300 million, but were revised downward as the method and pattern of nationalization came under prolonged debate. However, exploration activities did bring promising results with the discovery of two new fields. The state oil company, Corporación Venezolano de Petróleo (CVP), reported a wildcat discovery in western Monogas flowing at 4,500 bpd, and Mobil Oil Corp. reported a discovery in Lake Maracaibo flowing at 5,400 bpd. Drilling activity, combined with higher oil prices, added nearly 1 billion barrels to Venezuela's proven crude oil reserve, raising the total to 15 billion barrels by yearend.

Venezuela's crude oil production declined significantly as a result of cutback measures in effect in April 1974. Government regulations required that gas flaring be limited to 2% of production, thus reducing the daily production average from nearly 3.4 million barrels reported in 1973 to less than 3.0 million barrels in 1974. Gas-flaring limitations most seriously affected offshore production, where daily averages were reduced to 2.1 million barrels compared with 2.5 million barrels in 1973.

TECHNOLOGY

During 1974, new technology was developed for offshore applications. Recent developments included the following:[10] (1) Testing of electrohydraulic and acoustical subsea control systems as alternatives to all-hydraulic and total-electric systems; (2) introduction of several advanced tools for more efficient installation of pilings; (3) marketing of a multistage centrifugal compressor which reduced platform space requirements; (4) introduction of additional refinements in seismic equipment; and (5) development of a new navigation system capable of operating continuously up to 250 miles offshore.

In addition, sea tests in the Gulf of Mexico under actual producing conditions led Subsea Equipment Associates Ltd. and Lockheed Petroleum Services, Ltd., to claim operational capability for their shallow-water, atmospheric well-completion methods.[11] Work on the two systems at yearend was directed toward developing capabilities to manifold wells and lay underwater flowlines between facilities.

Sea tests for an offshore drilling structure that may eliminate many problems currently experienced with conventional offshore platforms were also scheduled.[12] Designated as the "Tension Leg Platform" by its designer (Deep Oil Technology, Inc.), the structure is a buoyant platform held in place by vertical cables attached to anchors. The cables remain taut at all times to prevent heaving as well as lateral movement.

Another type of drilling rig was designed by Gulf Offshore Co. of Houston to drill infill and replacement wells on producing platforms without interfering with normal production operations.[13] The new rig design saves two-thirds of the platform space normally required. Construction of the rig is facilitated by utilizing 30,000-pound modular units, which are assembled with a special crane.

Bethlehem Steel Corp. also introduced a new offshore rig designed to extend the water-depth capacity of jack-up platforms.[14] The advanced design features telescoping legs which extend jack-up capability to water depths of 377 feet. Most jack-ups are rated at depths of less than 300 feet. The first rig with the new design is scheduled for delivery in late 1976.

Two new products to protect marine areas from oil spills were introduced. The first device is a semisubmersible barrier developed by the Bridgestone Tire Co. of Japan.[15] In effect, the barrier acts as a fence that extends approximately 1.5 feet above water and about 2 feet below the surface. The second product is a barrier marketed by Steltner Development and Manufacturing Co., Ltd., St. Catharines, Ontario, Canada.[16] The developers claim that this device also can be used to channel spills during cleanup operations.

In March 1974, El Paso Natural Gas Co. announced a series of experiments to evaluate the concept of massive hydraulic fracturing as a viable alternative to nuclear stimulation of vast, low-permeability Rocky Mountain natural gas reservoirs.[17] The experimental program involves 18 separate stages of hydraulic fracturing over a 4-year period at two wells in Wyoming. The initial stage of the program commenced in September when 277,000 gallons of fluid with 775,000 pounds of sand were pumped into the first test well. Evaluation of this effort was incomplete at yearend, but it was apparent that initial gas-production rates after fracturing were only one-third of the values predicted.

In related experiments,[18] the Federal Government and 15 industrial sponsors began a joint program to compare costs of massive hydraulic fracturing with cost data obtained from the 1973 Rio Blanco nuclear stimulation project in Colorado. An additional nuclear stimulation experiment was proposed for a test site in Wyoming, but funding for the project was uncertain at yearend.

A new screw percussion bit designed to

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[10] World Oil. Advanced Controls and Tools will Cut Development Costs. V. 179, No. 1, July 1974, p. 99.

[11] World Oil. Subsea Production Systems Close to Being Operational. V. 179, No. 1, July 1974, p. 94.

[12] Petroleum Engineer International. Sea Tests Scheduled for Buoyant Platform. V. 46, No. 6, June 1974, p. 17.

[13] World Oil. What's Happening in Drilling Exploration. V. 179, No. 7, December 1974, p. 19.

[14] Oil and Gas Journal. New Jack-up Design Features Telescoping Legs. V. 27, No. 48, Dec. 2, 1974, p. 49.

[15] Petroleum Engineer International. Submersible Barrier Contains Oil Spills. V. 46, No. 9, August 1974, p. 17.

[16] Petroleum Engineer International. Cleanup Device for Flowing Water. V. 46, No. 6, June 1974, p. 17.

[17] World Oil. Massive Stimulation Efforts May Double U.S. Gas Supply. V. 179, No. 5, October 1974, p. 131.

[18] Work cited in footnote 16.

perform the same functions as rock, drag, and percussion bits was marketed during 1974.[19] Screw action removes cuttings in soft formations, but the hammer actuates for percussion drilling in hard formations. The bit was field-tested in Alaska.

A drilling mud additive to eliminate the dangerous effects of hydrogen sulfide on personnel and equipment was tested in the field and laboratory during the year.[20] The material reacts on contact with hydrogen sulfide to form safe, stable pyrite. Reaction efficiency is directly proportional to bottom-hole pressure. Moreover, the reaction is irreversible and is not influenced by pH, temperature, or time.

Continental Oil Co. developed a simplified device for shutting in pressure observation wells at the bottom of the drill hole to prevent fluid accumulation in the wellbore.[21] The device gives a positive shut-in of the wells during interference and pulse tests, thereby permitting straightforward analysis. A U.S. patent is pending.

A new electromechanical derrick-floor test system was developed for inspecting drill pipe during removal from the well.[22] Defects such as transverse fatigue cracks, corrosion, and mechanical cuts are detected as pipe is pulled at speeds up to 90 feet per minute. The testing apparatus is mobile and can also be utilized to inspect tubing strings.

Simultaneous rotation and reciprocation is possible with a new cementing tool introduced in 1974 by Fishing Tools, Inc.[23] The tool contains a cementing head and a hydraulically powered swivel that enables the operator to raise or lower pipe while it is being rotated. Initially, the tool will be marketed on the gulf coast.

A new annulus fluid was developed to facilitate the removal of drillpipe.[24] The fluid also lubricates and protects the pipe until it is pulled. In addition, logging and fishing tools were able to move easily through the drill hole when the fluid was employed.

In 1974, the Bureau of Mines research program was directed to enhance recovery of oil and gas based on a cooperative effort with industry. The program objective was to accelerate petroleum production and increase proved reserves. Field work was performed under contracts with industrial companies. Backup laboratory research was to be performed partly by the Bureau and partly by universities through grants. Field demonstrations of enhanced recovery methods were initiated on chemical explosive fracturing, massive hydraulic fracturing, and micellar-polymer flooding and will require 3 to 4 years to complete. All these projects were in early stages of development and expenditures, but will be expanded for the next several years.

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[19] World Oil. What's Happening in Drilling/Exploration. V. 178, No. 1, January 1974, p. 13.

[20] World Oil. New Mud Additive Will Neutralize H_2S. V. 179, No. 1, July 1974, p. 13.

[21] World Oil. New Downhole Shut-in Tool Boosts BHP Test Accuracy. V. 179, No. 6, November 1974, p. 71.

[22] World Oil. System Inspects Drill Pipe As It Comes Out of the Hole. V. 179, No. 6, November 1974, p. 101.

[23] World Oil. What's Happening in Production. V. 178, No. 7, June 1974, p. 13.

[24] World Oil. Special Annulus Fluid Eases Casing Recovery. V. 178, No. 5, April 1974, p. 117.

Table 2.—Supply, demand, and stocks of all oils in the United States
(Thousand barrels)

Item	1970	1971	1972	1973	1974 p
Domestic production:					
Crude oil	3,350,666	3,296,612	3,293,399	3,206,012	3,056,936
Lease condensate	166,784	157,302	161,969	154,891	145,649
Natural gas plant liquids	605,916	617,815	638,216	634,423	616,098
Imports: [1]					
Crude oil	483,293	613,417	811,135	1,183,996	1,269,155
Unfinished oils	39,261	45,193	45,705	50,161	44,228
Plant condensate	2,258	13,321	31,428	39,344	32,364
Refined products	723,250	760,949	847,046	1,009,992	876,432
Other hydrocarbons and hydrogen refinery input	6,238	6,074	10,118	10,716	13,057
Total new supply	5,377,666	5,510,683	5,839,016	6,289,535	6,053,919
Crude oil unaccounted for [2]	−7,721	+14,823	+10,201	+918	−9,084
Processing gain	131,052	139,433	142,161	165,488	175,255
Total supply	5,500,997	5,664,939	5,991,378	6,455,941	6,220,090
Change in stocks, all oils [3]	+37,738	+26,086	−84,968	+49,328	+65,339
Total disposition of primary supply	5,463,259	5,638,853	6,076,346	6,406,613	6,154,751
Exports: [4]					
Crude oil	4,991	503	187	697	1,074
Refined products	89,467	81,342	81,202	83,716	79,417
Crude oil losses	4,323	4,448	4,641	4,897	4,789
Domestic demand for products:					
Gasoline:					
Motor gasoline	2,111,349	2,195,267	2,333,778	2,436,156	2,386,177
Aviation gasoline	19,903	17,892	16,925	16,531	16,215
Total gasoline	2,131,252	2,213,159	2,350,703	2,452,687	2,402,392
Jet fuel:					
Naphtha-type	90,927	94,732	88,495	79,220	81,171
Kerosine-type	262,051	273,991	293,995	307,407	281,429
Total jet fuel	352,978	368,723	382,490	386,627	362,600
Ethane (including ethylene)	83,757	87,744	106,201	119,443	124,582
Liquefied gases	363,059	369,008	413,649	409,318	388,244
Kerosine	95,974	90,917	85,852	78,915	64,352
Distillate fuel oil	927,211	971,316	1,066,110	1,128,714	1,072,812
Residual fuel oil	804,288	838,045	925,647	1,030,177	957,811
Petrochemical feedstocks [5]	101,188	110,525	123,697	129,929	132,468
Special naphthas	31,390	29,762	31,866	32,230	31,976
Lubricants	49,693	49,321	52,813	59,171	56,670
Wax	4,607	5,248	5,409	6,941	6,801
Coke	77,215	79,897	88,276	95,156	87,056
Asphalt	153,477	158,526	163,788	182,602	168,733
Road oil	9,641	8,487	7,533	7,832	6,881
Still gas for fuel	163,905	156,967	170,998	176,758	175,724
Miscellaneous products	14,843	14,915	15,284	18,934	24,263
Plant condensate	--	--	--	1,869	6,106
Total domestic demand	5,364,478	5,552,560	5,990,316	6,317,303	6,069,471
Stocks of all oils:					
Crude oil and lease condensate	276,367	259,648	246,395	242,478	265,020
Unfinished oils	98,989	100,574	94,761	99,154	106,031
Natural gasoline [6]	6,088	5,163	4,802	6,160	6,480
Plant condensate	958	1,013	1,273	1,675	1,070
Refined products	635,459	677,549	611,748	658,840	695,045
Total	1,017,861	1,043,947	958,979	1,008,307	1,073,646

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p Preliminary (except for domestic production of crude oil and lease condensate).

[1] U.S. Department of the Interior data for crude oil, unfinished oils, and plant condensate; U.S. Department of Commerce and Federal Energy Administration data for all other imports. Imports of crude oil include some Athabasca hydrocarbons.

[2] Represents the difference between supply and indicated demand for crude petroleum.

[3] Minus sign represents withdrawal from stocks, which is added to total disposition; plus sign represents stocks increase, which is subtracted from total disposition.

[4] U.S. Department of Commerce data.

[5] Produced at petroleum refineries. Demands for ethane and liquefied gases used for petrochemical feedstocks are excluded. Demand data for these products for petrochemical feedstocks used are included under the items "Ethane" and "Liquefied gases."

[6] Includes isopentane.

Table 3.—Supply and demand of all oils in the United States, by month

(Thousand barrels)

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
1973													
New supply:													
Domestic production:													
Crude oil	270,863	250,559	273,800	265,736	274,438	263,686	272,847	271,381	259,640	273,071	262,223	267,768	3,206,012
Lease condensate	13,591	12,507	12,630	13,021	12,696	12,782	12,884	12,844	12,319	12,869	12,606	13,192	154,891
Natural gas plant liquids	52,081	48,857	53,769	52,488	53,917	51,801	53,846	54,183	52,238	54,444	53,219	53,585	634,428
Imports:[1]													
Crude petroleum	84,693	80,433	98,021	91,459	99,654	96,613	108,530	111,368	104,117	115,905	103,570	89,633	1,183,996
Unfinished oils	3,278	2,479	4,181	4,786	4,002	4,642	4,475	4,515	4,601	3,588	4,953	4,661	50,161
Plant condensate	3,367	3,411	3,507	3,340	3,205	2,622	3,472	3,419	3,204	3,096	3,464	3,237	39,344
Refined products	90,232	95,881	99,206	68,216	74,208	72,831	75,070	85,023	80,422	83,022	95,683	90,198	1,009,992
Other hydrocarbons and hydrogen refinery input	856	942	1,000	700	989	846	978	948	905	896	749	908	10,716
Total new supply	518,961	495,069	547,114	499,746	523,109	505,778	532,102	543,681	517,441	546,890	536,467	523,182	6,289,535
Crude oil unaccounted for[2]	+612	−3,637	+2,352	+1,466	+3,924	+5,041	−2,979	+2,046	−5,121	−110	−2,337	−339	+918
Processing gain	14,188	11,476	12,452	11,205	16,536	14,817	14,596	14,579	13,752	15,596	12,907	13,384	165,488
Total supply	533,761	502,908	561,918	512,417	543,569	525,631	543,719	560,306	526,072	562,376	547,037	536,227	6,455,941
Change in stocks, all oils[3]	−53,268	−39,406	+20,857	+26,138	+20,399	+24,312	+28,287	+10,657	+18,686	+21,799	−14,202	−14,931	+49,328
Total disposition of primary supply	587,029	542,314	541,061	486,279	523,170	501,319	515,432	549,649	507,386	540,577	561,239	551,158	6,406,613
Exports:[4]													
Crude oil	--	--	-	-	128	-	232	--	160	--	--	177	697
Refined products	6,529	7,307	6,950	8,267	7,231	6,463	7,231	6,768	7,130	6,883	6,077	6,885	83 716
Crude oil losses	408	371	408	396	411	416	425	422	407	425	401	407	4,897
Domestic demand for products:													
Gasoline:													
Motor gasoline	189,647	180,223	201,901	196,243	214,125	208,912	217,717	224,955	197,417	206,985	204,689	193,342	2,436,156
Aviation gasoline	1,225	1,236	1,315	1,277	1,572	1,349	1,202	1,913	1,324	1,575	1,361	1,182	16,531
Total gasoline	190,872	181,459	203,216	197,520	215,697	210,261	218,919	226,868	198,741	208,560	206,050	194,524	2,452,687
Jet fuel:													
Naphtha-type	6,072	5,312	5,869	7,437	6,818	6,711	6,134	7,241	6,413	7,905	5,892	7,416	79,220
Kerosine-type	28,337	25,215	24,935	24,007	27,667	23,510	26,293	25,283	25,698	26,331	24,857	26,274	307,407
Total jet fuel	34,409	30,527	30,804	30,444	34,485	30,221	32,427	32,524	32,111	34,236	30,749	33,690	386,627
Ethane (including ethylene)	9,634	9,089	10,414	9,796	9,882	9,694	9,633	10,224	9,568	10,083	10,789	10,637	119,443

See footnotes at end of table.

Table 3.—Supply and demand of all oils in the United States, by month—Continued

(Thousand barrels)

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
Domestic demand for products—Continued													
Liquefied gases:													
LRG for fuel use[5]	8,161	7,773	7,209	7,437	7,919	6,536	7,866	7,210	7,511	7,037	7,549	7,446	89,654
LRG for chemical use[5]	3,240	2,868	3,295	3,043	3,405	3,049	3,389	3,313	3,378	3,230	2,937	2,848	38,040
LPG for fuel and chemical use[6]	40,781	32,267	22,653	18,621	18,099	15,194	13,314	18,716	18,195	25,682	29,541	28,611	281,624
Total liquefied gases	52,182	42,908	33,157	29,101	29,423	24,779	24,569	29,239	29,084	35,949	40,027	38,905	409,318
Kerosine	12,585	10,784	6,222	4,894	4,102	3,529	4,602	4,546	5,534	5,563	9,168	7,386	78,915
Distillate fuel oil	128,286	120,447	103.451	79,037	82,851	72,560	72,175	79,208	80,241	90,834	105,230	114,394	1,128,714
Residual fuel oil	102,485	94,684	95,589	74,296	78,165	78.214	74.764	85.419	80,279	80,290	94,729	91,263	1,030,177
Petrochemical feedstocks:[7]													
Still gas	1,327	840	1,183	1,019	1,222	1,054	916	1,188	1,015	884	902	878	12,428
Naphtha-400°[8]	4,954	4,447	4,380	4,700	4,286	4,230	4,718	4,775	4,790	4,811	5,339	5,392	56,822
Other	4,878	4,428	5,111	5,466	4,729	5,232	5,178	5,256	4,848	5,043	5,016	5,494	60,679
Total petrochemical feedstock	11,159	9,715	10,674	11,185	10,237	10,516	10,812	11,219	10,653	10,738	11,257	11,764	129,929
Special naphthas	2,793	2,697	2,806	2,045	3,129	2,630	2,714	2,956	2,499	2,995	2,453	2,513	32,230
Lubricants	4,616	4,562	4,918	4,860	5,148	4,479	5,480	5,285	4,629	5,699	5,052	4,993	59,171
Wax	518	484	591	468	646	558	521	666	584	650	687	578	6,941
Coke	8,372	6,890	7,524	7,211	8,012	8,404	8,287	8,643	7,492	8,878	7,605	7,838	95,156
Asphalt	5,592	5,974	7,734	11,090	16,110	20,061	23,429	26,123	21,068	20,944	15,140	9,837	182,602
Road oil	101	92	191	242	742	1,246	1,278	1,540	967	847	448	188	7,832
Still gas	15,018	13,129	14,901	14,420	14,854	15,665	16,258	15,911	14,487	14,768	13,369	13,978	176,758
Miscellaneous products	1,470	1,200	1,458	1,437	1,865	1,628	1,535	1,840	1,483	1,804	1,732	1,482	18,934
Plant condensate	--	--	53	75	52	--	191	258	269	431	276	269	1,869
Total domestic demand	580,092	534,636	533,703	477,616	515,400	494,440	507,544	542,464	499,689	533,269	554,761	543,689	6,317,308
Stocks all oils:													
Crude oil and lease condensate	237,469	235,362	244,131	248,783	257,867	248,857	243,673	248,314	241,276	246,297	249,998	242,478	242,478
Unfinished oils	87,767	87,583	97,646	104,956	105,404	103,615	102,307	98,925	101,904	102,499	103,586	99,154	99,154
Natural gasoline[9]	4,825	4,760	4,603	5,173	5,460	5,715	5,653	6,014	5,917	6,363	6,390	6,160	6,160
Plant condensate	1,364	1,345	1,358	1,497	1,858	1,649	1,517	1,479	1,548	1,401	1,679	1,675	1,675
Refined products	574,286	537,255	539,429	552,891	568,110	598.175	633,148	642,228	664,996	680,880	661,585	658,840	658,840
Total	905.711	866.305	887,162	913.300	938,699	958,011	986,298	996,955	1,015,641	1,037,440	1,023,238	1,008,307	1,008,307

1974 p												
New supply:												
Domestic production:												
Crude oil	263,727	244,169	265,163	256,234	263,749	251,744	260,270	257,757	241,917	254,933	244,789	252,484	3,056,936
Lease condensate	13,223	11,818	12,764	12,385	12,479	11,663	11,914	11,908	11,371	12,016	12,275	11,838	145,649
Natural gas plant liquids	52,672	48,392	53,983	50,872	52,879	50,514	51,354	51,942	49,144	52,268	50,817	51,761	616,098
Imports: [1]													
Crude oil	73,839	62,940	76,329	98,011	121,139	117,747	126,835	121,684	113,907	118,096	118,739	119,939	1,269,155
Unfinished oils	3,632	3,315	5,063	6,443	6,564	3,634	3,805	3,799	1,456	2,300	1,977	2,240	44,228
Plant condensate	3,054	3,438	3,238	3,050	2,000	2,387	2,427	2,488	2,693	2,825	2,718	2,051	32,364
Refined products	85,472	76,498	77,027	71,601	71,420	68,784	68,092	69,157	62,590	67,434	76,425	81,932	876,432
Other hydrocarbons and hydrogen refinery input	977	1,123	751	1,200	1,174	1,203	1,246	1,505	1,005	903	994	976	13,057
Total new supply	496,596	451,683	494,318	499,796	530,904	507,676	525,943	520,190	484,083	510,775	508,734	523,221	6,053,919
Crude oil unaccounted for [2]	−2,532	+714	+2,484	+607	−918	−33	−1,109	−2,324	−784	−597	−3,148	−1,444	−9,084
Processing gain	14,853	12,109	12,952	14,344	12,843	15,349	16,030	16,656	14,901	16,703	14,517	13,998	175,255
Total supply	508,917	464,506	509,754	514,747	542,829	522,992	540,864	534,522	498,200	526,881	520,103	535,775	6,220,090
Change in stocks, all oils [3]	−33,244	−27,892	+5,924	+29,491	+47,449	+30,162	+27,250	+13,514	+12,874	−8,153	−2,336	−29,700	+65,339
Total disposition of primary supply	542,161	492,398	503,830	485,256	495,380	492,830	513,614	521,008	485,326	535,034	522,439	565,475	6,154,751
Exports: [4]													
Crude oil	534	281	--	15	200	44	--	--	--	--	--	--	1,074
Refined products	5,874	5,399	6,064	7,285	7,448	7,108	7,849	7,664	5,126	6,847	5,594	7,164	79,417
Crude losses	386	341	382	385	412	411	427	422	394	411	400	418	4,789
Domestic demand for products:													
Gasoline:													
Motor gasoline	179,935	170,797	191,020	193,708	209,107	207,577	215,732	218,904	191,628	208,078	196,396	203,295	2,386,177
Aviation gasoline	1,265	870	1,655	1,276	1,325	1,511	1,373	1,835	1,341	1,595	1,172	997	16,215
Total gasoline	181,200	171,667	192,675	194,984	210,432	209,088	217,105	220,739	192,969	209,673	197,568	204,292	2,402,392
Jet fuel:													
Naphtha-type	5,365	4,687	6,306	6,527	8,399	7,262	6,627	7,404	7,891	7,089	7,202	6,462	81,171
Kerosine-type	22,385	19,442	23,320	21,689	24,248	21,289	25,244	24,557	25,389	24,257	23,752	25,857	281,429
Total jet fuel	27,750	24,079	29,626	28,216	32,647	28,551	31,871	31,961	33,280	31,346	30,954	32,319	362,600
Ethane (including ethylene)	10,405	9,983	11,417	10,073	9,881	9,649	10,041	10,255	9,855	11,020	10,954	11,049	124,582
Liquefied gases:													
LRG [5] for fuel use	7,052	6,403	6,679	7,004	7,018	6,653	7,725	7,103	7,564	6,821	6,730	6,455	83,207
LRG [5] for chemical use	3,036	2,802	3,279	2,993	2,553	3,135	3,094	3,425	3,300	3,198	2,547	2,213	35,575
LPG [6] for fuel and chemical use	34,268	25,020	21,852	18,904	16,432	17,615	15,277	16,447	19,510	24,699	27,128	32,310	269,462

See footnotes at end of table.

Table 3.—Supply and demand of all oils in the United States, by month—Continued

(Thousand barrels)

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
New Supply—Continued													
Liquefied gases—Continued													
Total liquefied gases	44,356	34,225	31,810	28,901	26,003	27,403	26,096	26,975	30,374	34,718	36,405	40,978	388,244
Kerosine	9,657	7,866	5,518	3,899	2,210	3,442	3,864	4,360	4,136	5,964	5,866	7,570	64,352
Distillate fuel oil	118,426	107,384	97,488	85,444	76,053	71,575	71,376	71,157	71,298	88,753	94,358	119,505	1,072,812
Residual fuel oil	94,079	84,273	78,003	72,949	69,782	73,636	75,382	78,706	73,605	80,916	84,568	91,912	957,811
Petrochemical feedstocks:[7]													
Still gas	1,263	877	799	795	889	1,232	1,184	1,308	1,298	1,464	1,246	2,020	14,375
Naphtha-400°	4,825	4,957	4,911	4,164	5,089	5,162	5,915	6,178	5,369	5,367	5,137	4,805	61,879
Other	4,674	4,152	4,237	4,023	3,705	4,026	5,383	5,029	5,039	5,163	5,730	5,053	56,214
Total petrochemical feedstocks	10,762	9,986	9,947	8,982	9,683	10,420	12,482	12,515	11,706	11,994	12,113	11,878	132,468
Special naphthas	2,667	2,668	2,730	3,014	2,881	2,451	2,817	2,820	2,602	2,843	2,391	2,092	31,976
Lubricants	5,230	4,360	4,915	4,697	5,211	4,093	4,997	4,515	4,869	5,013	4,355	4,415	56,670
Wax	695	513	624	556	600	591	624	623	513	561	508	393	6,801
Coke	7,789	6,969	8,164	7,033	6,594	7,119	7,040	7,192	7,760	6,605	7,118	7,673	87,056
Asphalt	6,873	7,687	9,298	12,074	16,911	18,111	20,059	20,378	19,213	19,381	12,064	6,734	168,783
Road oil	115	137	156	342	479	948	1,198	1,109	953	949	407	88	6,881
Still gas	13,833	12,543	13,285	14,472	14,835	15,616	16,869	16,545	14,220	14,981	14,217	14,308	175,724
Miscellaneous products	1,530	1,333	1,302	1,272	2,421	2,354	2,865	2,454	1,891	2,509	2,084	2,248	24,263
Plant condensate	--	[8] 754	431	663	702	220	652	618	562	550	515	439	6,106
Total domestic demand	535,367	486,377	497,384	477,571	487,325	485,267	505,838	512,922	479,806	527,776	516,445	557,893	6,069,471
Stocks all oils:													
Crude oil and lease condensate	233,035	240,723	244,665	256,385	269,455	268,765	268,686	264,840	266,726	269,437	271,144	265,020	265,020
Unfinished oils	97,862	95,077	106,861	109,501	116,748	118,720	116,727	113,223	109,554	110,002	109,136	106,031	106,031
Natural gasoline[9]	6,428	6,705	6,542	7,096	7,445	7,908	7,784	7,888	7,955	7,232	6,860	6,480	6,480
Plant condensate	1,608	1,445	1,770	1,330	1,097	1,216	1,049	1,062	1,120	1,167	1,243	1,070	1,070
Refined products	636,130	603,221	593,257	608,274	635,290	663,588	693,201	713,948	728,480	717,844	714,963	695,045	695,045
Total	975,063	947,171	953,095	982,586	1,030,035	1,060,197	1,087,447	1,100,961	1,113,835	1,105,682	1,103,346	1,073,646	1,073,646

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[p] Preliminary (except for domestic production of crude oil and lease condensate).

[1] U.S. Department of the Interior data for crude oil, unfinished oils, and plant condensate; U.S. Department of Commerce and Federal Energy Administration data for all other imports. Imports of crude oil include some Athabasca hydrocarbons.

[2] Represents the difference between supply and indicated demand for crude oil.

[3] Minus sign represents withdrawal from stock, which is added to total disposition; plus sign represents stocks increase, which is subtracted from total disposition.

[4] U.S. Department of Commerce data.

[5] Liquefied refinery gas.

[6] Liquefied petroleum gas.

[7] Produced at petroleum refineries. Demands for ethane and liquefied gases used for petrochemical feedstocks are excluded. Demand data for these products for petrochemical feedstock use are included under items "Ethane" and "Liquefied gases."

[8] Includes January data of 372,000 barrels.

[9] Includes isopentane.

Table 4.—Supply, demand, and stocks of all oils in 1974, by PAD district
(Thousand barrels)

	District I	District II	District III	District IV	Total District I–IV	District V	Total United States
Domestic production:							
Crude oil and lease condensate	43,393	334,521	2,178,774	251,422	2,808,110	394,475	3,202,585
Natural gas plant condensate	8,810	90,819	487,756	17,212	604,597	11,501	616,098
Receipts from other districts	1,075,720	953,011	74,997	22,441	8,482	67,639	--
Imports:							
Natural gasoline and plant condensate	2,903	19,012	126	8,250	30,291	2,073	32,364
Crude oil	428,608	250,771	289,999	16,579	985,957	283,198	1,269,155
Unfinished oils	14,084	1,155	19,208	--	34,447	9,781	44,228
Refined products	746,870	30,864	41,888	5,909	825,531	50,901	876,432
Other hydrocarbon and hydrogen input	901	999	6,247	315	8,462	4,595	13,057
Total new supply	2,321,289	1,681,152	3,098,995	322,128	5,305,877	824,163	6,053,919
Crude oil unaccounted for	531	20,624	−35,011	5,250	−8,606	−478	−9,084
Processing gain	23,133	49,061	68,300	3,392	143,886	31,369	175,255
Total supply	2,344,953	1,750,837	3,132,284	330,770	5,441,157	855,054	6,220,090
Change in stocks, all oils [1]	−3,577	+20,427	+33,495	+2,407	+52,752	+12,587	+65,339
Total disposition of supply	2,348,530	1,730,410	3,098,789	328,363	5,388,405	842,467	6,154,751
Exports:							
Crude oil	--	--	966	108	1,074	--	1,074
Refined products	6,168	3,533	36,165	66	45,932	33,485	79,417
Shipments to other districts	88,866	77,505	1,862,350	156,605	67,639	8,482	--
Crude losses [2]	638	553	2,768	433	4,392	397	4,789
Domestic demand for products:							
Gasoline:							
Motor gasoline	784,892	816,839	362,069	76,430	2,040,230	345,947	2,386,177
Aviation gasoline	3,379	4,144	3,973	630	12,126	4,089	16,215
Total gasoline	788,271	820,983	366,042	77,060	2,052,356	350,036	2,402,392
Jet fuel:							
Naphtha-type	20,739	15,256	18,085	2,983	57,063	24,108	81,171
Kerosine-type	114,345	55,010	25,339	7,840	202,534	78,895	281,429
Total jet fuel	135,084	70,266	43,424	10,823	259,597	103,003	362,600
Ethane (including ethylene)	1,686	14,899	107,244	242	124,071	511	124,582
Liquefied gases	57,725	128,286	172,507	9,431	367,949	20,295	388,244
Kerosine	27,122	18,815	14,182	1,165	61,284	3,068	64,352
Distillate fuel oil	488,836	320,956	129,206	38,760	977,758	95,054	1,072,812
Residual fuel oil	622,214	87,689	92,371	12,452	814,726	143,085	957,811
Petrochemical feedstocks	11,161	10,808	104,380	114	126,463	6,005	132,468
Special naphthas	7,435	10,975	8,004	149	26,563	5,413	31,976
Lubricants	22,784	13,704	14,810	713	52,011	4,659	56,670
Wax	2,105	1,346	2,048	100	5,599	1,202	6,801
Coke	11,778	35,596	25,219	4,021	76,614	10,442	87,056
Asphalt	49,279	56,270	30,707	9,861	146,117	22,616	168,733
Road oil	410	3,920	45	539	4,914	1,967	6,881
Still gas for fuel	19,257	44,448	75,335	5,642	144,682	31,042	175,724
Plant condensate	--	6,106	--	--	6,106	--	6,106
Miscellaneous products	7,711	3,752	11,016	79	22,558	1,705	24,263
Total domestic demand	2,252,858	1,648,819	1,196,540	171,151	5,269,368	800,103	6,069,471
Stocks for all oils:							
Crude oil and lease condensate	16,864	79,553	110,410	15,807	222,634	42,386	265,020
Unfinished oils	15,055	22,143	39,600	2,900	79,698	26,333	106,031
Natural gasoline and plant condensate	165	1,622	5,458	218	7,463	87	7,550
Refined products	194,129	201,596	213,178	17,705	626,608	68,437	695,045
Total	226,213	304,914	368,646	36,630	936,403	137,243	1,073,646

[1] Minus sign represents withdrawal from stocks, which is added to total disposition; plus sign represents stocks increase, which is subtracted from total disposition.

[2] Estimated for individual districts I through IV.

Table 5.—Production of crude petroleum (including lease condensate) in the United States, by State and month

(Thousand barrels)

State	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
1973													
Alabama	839	871	1,041	1,024	1,007	978	1,039	954	974	978	969	1,008	11,677
Alaska	6,033	6,061	5,386	5,901	6,195	5,937	6,248	6,425	6,018	6,213	5,844	6,062	72,323
Arizona	76	74	76	72	65	69	62	68	63	58	58	63	804
Arkansas	1,547	1,427	1,522	1,508	1,510	1,462	1,517	1,547	1,537	1,531	1,439	1,469	18,016
California:													
South	11,518	10,495	11,565	11,048	11,292	10,880	11,142	11,095	10,659	10,949	10,630	10,924	132,192
Central coastal	6,609	6,031	6,701	6,471	6,708	6,614	6,788	6,748	6,428	6,685	6,410	6,537	78,720
East central	10,494	9,494	10,511	10,243	10,626	10,253	10,482	10,532	10,147	10,657	10,297	10,722	124,458
North	65	57	61	60	62	56	54	59	57	57	59	58	705
Total California	28,686	26,077	28,838	27,817	28,688	27,803	28,461	28,434	27,286	28,348	27,396	28,241	336,075
Colorado	2,883	2,715	2,821	2,858	3,027	3,098	3,507	2,826	3,188	3,295	3,202	3,170	36,590
Florida	2,583	2,627	2,918	2,713	2,770	2,585	2,692	2,767	2,719	2,769	2,758	2,794	32,695
Illinois	2,779	2,416	2,748	2,616	2,747	2,506	2,511	2,601	2,423	2,576	2,442	2,304	30,669
Indiana	456	424	464	435	460	422	467	445	417	462	444	416	5.312
Kansas	5,677	5,416	5,605	5,669	5,925	5,628	5,557	5,672	5,212	5,664	5,269	4,933	66,227
Kentucky	713	807	786	765	726	705	736	750	659	746	639	655	8,687
Louisiana:													
Gulf coast	69,385	62,417	69,230	66,836	67,940	65,705	62,287	66,949	60,463	66,215	63,685	64,648	791,760
Rest of State	3,544	3,223	3,449	3,020	3,013	3,069	3,327	3,444	3,304	3,465	3,383	3,523	39,764
Total Louisiana	72,929	65,640	72,679	69,856	70,953	68,774	71,614	70,393	63,767	69,680	67,068	68,171	831,524
Michigan	1,171	1,069	1,020	1,219	1,272	1,202	1,253	1,267	1,206	1,310	1,245	1,380	14,614
Mississippi	5,024	4,314	4,848	4,633	4,751	4,571	4,768	4,787	4,606	4,669	4,520	4,611	56,102
Missouri	5	5	5	5	5	5	5	5	5	5	5	5	60
Montana	2,866	2,501	2,963	2,807	2,997	2,863	2,887	2,921	2,868	3,035	2,911	3,001	34,620
Nebraska	658	591	602	589	630	614	622	623	579	600	575	562	7,240
Nevada	9	8	8	8	8	8	8	7	7	9	8	8	96
New Mexico:													
Southeastern	8,049	7,387	8,191	7,796	8,052	7,676	7,719	7,716	7,452	7,938	7,679	7,761	93,416
Northwestern	643	562	597	625	644	616	622	610	625	688	652	686	7,570
Total New Mexico	8,692	7,949	8,788	8,421	8,696	8,292	8,341	8,326	8,077	8,626	8,331	8,447	100,986
New York	72	64	74	84	90	84	86	84	82	86	81	80	967
North Dakota	1,723	1,602	1,684	1,655	1,783	1,638	1,687	1,701	1,690	1,728	1,682	1,662	20,235
Ohio	657	584	685	778	828	785	780	782	716	752	724	725	8.796
Oklahoma	15,917	17,071	16,080	15,292	16,376	15,748	16,217	15,579	16,228	15,955	14,885	15,856	191,204
Pennsylvania	278	265	252	238	295	280	288	293	262	304	272	260	3,282
South Dakota	18	17	17	17	18	18	19	28	28	30	34	31	275
Tennessee	17	16	17	16	17	16	18	18	16	17	16	17	201

Texas:													
District 01	1,893	1,721	1,901	1,805	1,831	1,712	1,763	1,746	1,676	1,720	1,661	1,714	21,143
District 02	6,637	5,976	6,665	6,511	6,694	6,371	6,558	6,580	6,332	6,501	6,233	6,391	77,449
District 03	14,996	13,631	15,835	14,781	15,009	14,338	14,888	14,856	14,349	14,876	14,204	14,594	175,847
District 04	5,178	4,745	5,418	5,279	5,297	5,056	5,120	5,019	4,754	4,859	4,638	4,728	60,091
District 05	2,787	2,554	2,760	2,675	2,772	2,710	2,791	2,819	2,668	2,784	2,690	2,753	32,763
District 06, except East Texas	6,757	6,287	6,942	6,678	6,744	6,503	6,628	6,761	6,524	6,756	6,485	6,725	79,785
East Texas	6,544	5,911	6,512	6,273	6,461	6,248	6,362	6,338	6,117	6,294	6,122	6,297	75,479
District 07B	3,051	2,873	3,192	3,020	3,116	2,976	3,030	3,024	2,925	3,037	2,962	3,026	36,282
District 07C	3,496	3,194	3,530	3,355	3,387	3,245	3,333	3,302	3,208	3,343	3,201	3,232	39,826
District 08	23,421	21,692	24,129	23,339	23,985	22,984	23,697	23,848	22,963	23,955	23,132	23,706	280,851
District 08A	27,776	25,573	28,734	27,884	29,076	27,855	29,912	29,970	29,130	30,581	29,735	30,758	346,984
District 09	3,918	3,663	4,078	3,921	3,992	3,816	3,862	3,839	3,699	3,805	3,669	3,688	45,950
District 10	1,882	1,799	1,964	1,850	1,957	1,859	1,873	1,847	1,775	1,866	1,778	1,821	22,271
Total Texas	108,336	99,619	111,160	107,371	110,321	105,668	109,807	109,949	106,120	110,377	106,510	109,433	1,294,671
Utah	2,348	2,220	2,390	2,818	2,723	2,705	2,777	2,828	2,732	3,116	2,914	3,090	32,656
West Virginia	221	185	217	193	207	190	180	189	169	223	209	202	2,385
Wyoming	11,246	10,431	11,736	11,379	12,044	11,764	11,582	11,961	12,305	12,778	12,879	12,309	141,914
Total United States:													
1973	284,454	263,066	287,430	278,757	287,134	276,418	285,731	284,225	271,959	285,940	274,829	280,960	3,360,903
1972	282,543	270,749	293,311	285,389	298,043	285,646	294,385	293,958	285,249	293,929	282,793	289,373	3,455,368
Daily average, 1973	9,176	9,395	9,272	9,292	9,262	9,214	9,217	9,169	9,065	9,224	9,161	9,063	9,208
Pennsylvania-grade crude oil (included in U.S. total)	941	847	926	1,002	1,095	1,034	1,034	1,058	970	1,122	1,034	1,027	12,090
1974													
Alabama	1,014	888	1,015	953	1,005	1,002	1,203	1,265	1,228	1,258	1,204	1,288	13,323
Alaska	5,932	5,323	5,686	5,402	5,925	6,048	6,273	6,203	5,894	6,101	5,881	5,935	70,603
Arizona	56	54	67	62	67	63	63	66	63	60	59	60	740
Arkansas	1,383	1,333	1,492	1,447	1,458	1,368	1,455	1,303	1,242	1,318	1,333	1,400	16,527
California:													
South	10,841	9,846	10,890	10,362	10,722	10,064	10,579	10,692	10,293	10,600	10,282	10,512	125,683
Central coastal	6,434	5,862	6,458	6,258	6,388	6,221	6,408	6,410	6,189	6,415	6,214	6,346	75,603
East Central	10,681	9,616	10,320	9,985	10,266	9,967	10,143	10,234	9,806	10,148	9,922	10,138	121,171
North	55	46	47	45	43	41	45	43	44	47	45	45	546
Total California	28,011	25,370	27,715	26,600	27,419	26,298	27,175	27,879	26,832	27,210	26,463	27,036	323,003
Colorado	3,108	2,923	3,156	3,221	3,083	3,089	3,155	3,266	3,062	3,177	3,177	3,096	37,508
Florida	2,838	2,712	2,891	3,085	3,317	3,126	3,087	3,096	2,998	3,105	3,011	3,085	36,351
Illinois	2,344	2,188	2,351	2,395	2,407	2,208	2,370	2,290	2,229	2,354	2,171	2,246	27,553
Indiana	424	390	409	420	430	376	441	417	397	428	395	392	4,919
Kansas	5,127	4,947	5,339	5,304	5,400	5,068	5,302	5,182	4,987	5,185	4,859	4,996	61,691
Kentucky	675	640	687	667	714	635	672	710	631	655	560	591	7,837
Louisiana:													
Gulf coast	64,347	57,942	62,898	60,292	61,220	57,748	59,851	59,385	43,948	56,993	54,273	54,596	698,488
Rest of State	3,314	2,935	3,167	3,169	3,287	3,280	3,338	3,392	3,195	3,337	3,193	3,229	38,836

Table 5.—Production of crude petroleum (including lease condensate) in the United States by State and month—Continued

(Thousand barrels)

State	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
Total Louisiana	67,661	60,877	66,065	63,461	64,507	61,028	63,189	62,777	52,138	60,330	57,466	57,825	737,324
Michigan	1,365	1,210	1,355	1,422	1,479	1,440	1,521	1,629	1,602	1,713	1,623	1,662	18,021
Mississippi	4,608	3,916	4,412	4,253	4,362	4,198	4,313	4,248	4,065	4,233	4,067	4,104	50,779
Missouri	5	4	5	4	5	4	5	5	4	5	5	5	56
Montana	2,910	2,669	3,031	2,992	3,012	2,842	2,858	2,885	2,853	2,914	2,741	2,847	34,554
Nebraska	540	520	577	555	564	541	570	569	547	559	587	532	6,611
Nevada	9	8	8	6	9	18	14	13	10	12	11	11	129
New Mexico:													
Southeastern	6,777	7,152	7,943	7,549	7,853	7,497	7,630	7,591	7,594	7,786	7,554	7,769	90,695
Northwestern	635	603	686	677	686	665	703	689	670	673	658	655	8,000
Total New Mexico	7,412	7,755	8,629	8,226	8,539	8,162	8,333	8,280	8,264	8,459	8,212	8,424	98,695
New York	77	71	68	80	77	73	76	77	76	78	73	70	896
North Dakota	1,642	1,500	1,695	1,643	1,659	1,629	1,669	1,682	1,680	1,673	1,619	1,656	19,697
Ohio	675	673	727	750	844	749	848	742	715	795	789	781	9,088
Oklahoma	14,807	15,459	15,454	13,981	15,308	14,755	15,295	14,324	14,577	14,318	14,016	15,491	177,785
Pennsylvania	297	262	282	286	309	292	327	311	277	296	268	271	3,478
South Dakota	39	38	41	38	41	34	40	42	44	47	45	45	494
Tennessee	64	64	64	64	64	64	64	64	64	64	64	65	769
Texas:													
District 01	1,690	1,586	1,718	1,603	1,647	1,565	1,618	1,585	1,511	1,568	1,527	1,570	19,138
District 02	6,278	5,589	6,198	5,943	6,199	5,903	6,007	6,065	5,745	5,971	5,774	5,918	71,590
District 03	14,054	13,521	14,976	14,777	15,179	14,549	14,940	15,018	14,484	14,814	14,158	14,526	174,996
District 04	4,744	4,254	4,586	4,403	4,412	4,206	4,286	4,239	4,048	4,206	3,976	4,127	51,487
District 05	1,822	1,642	1,809	1,749	1,801	1,729	1,766	1,788	1,689	1,764	1,705	1,731	20,995
District 06, except East Texas	7,458	6,698	7,417	7,110	7,253	6,931	7,179	7,127	6,913	7,044	6,751	6,947	84,828
East Texas	6,257	5,664	6,244	6,054	6,218	5,987	6,076	6,036	5,829	6,021	5,832	5,984	72,202
District 07B	3,065	2,841	3,131	3,064	3,140	3,011	3,093	3,054	2,925	2,996	2,890	2,980	36,190
District 07C	2,852	2,557	2,818	2,646	2,671	2,554	2,617	2,591	2,359	2,517	2,420	2,516	31,118
District 08	23,845	21,613	23,859	22,922	23,585	22,625	23,227	22,989	22,203	22,881	22,017	22,670	274,436
District 08A	30,522	27,721	30,765	29,563	30,348	29,462	30,655	30,041	29,822	31,115	30,337	31,407	361,758
District 09	3,720	3,416	3,717	3,560	3,632	3,472	3,539	3,494	3,357	3,457	3,311	3,405	42,080
District 10	1,798	1,687	1,860	1,832	1,857	1,775	1,823	1,807	1,736	1,616	1,729	1,788	21,308
Total Texas	108,105	98,739	109,098	105,226	107,942	103,769	106,826	105,834	102,621	105,970	102,427	105,569	1,262,126
Utah	3,030	3,249	3,455	3,290	3,288	3,147	3,386	3,435	3,386	3,334	3,160	3,203	39,363
Virginia	1	--	--	--	1	--	--	--	1	--	--	--	3
West Virginia	206	221	206	334	223	193	214	187	219	231	196	235	2,665
Wyoming	12,590	11,979	11,947	12,452	12,770	11,203	11,440	11,384	11,132	11,067	10,632	11,401	139,997
Total United States:													
1974	276,950	255,982	277,927	268,619	276,228	263,407	272,184	269,665	253,288	266,949	257,064	264,322	3,202,585
1973	284,454	263,066	287,430	278,757	287,134	276,418	285,731	284,225	271,959	285,940	274,829	280,960	3,360,903
Daily average, 1974	8,934	9,142	8,965	8,954	8,911	8,780	8,780	8,699	8,443	8,611	8,569	8,527	8,774
Pennsylvania-grade crude oil (included in U.S. total)	1,104	1,069	1,120	1,253	1,171	1,034	1,191	1,060	1,035	1,162	1,083	1,103	13,385

Sources of 1974 data:

Alabama	Alabama State Oil and Gas Board.
Alaska	Alaska Department of Natural Resources.
Arizona	Arizona Oil and Gas Commission.
Arkansas	Arkansas Oil and Gas Commission.
California	Division of Oil and Gas, California Department of Conservation.
Colorado	Colorado Oil and Gas Conservation Commission.
Florida	Florida Department of Natural Resources.
Illinois	Illinois State Geological Survey.
Indiana	Indiana Department of Natural Resources.
Kansas	Kansas Corporation Commission.
Kentucky	Kentucky Geological Survey.
Louisiana	Louisiana Department of Conservation and U.S. Geological Survey.
Michigan	Michigan Department of Natural Resources.
Mississippi	Mississippi State Oil and Gas Board.
Missouri	Missouri Geological Survey and Water Resources.
Montana	Montana Department of Natural Resources and Conservation.
Nebraska	Nebraska Oil and Gas Conservation Commission.
Nevada	Nevada Bureau of Mines and Geology.
New Mexico	New Mexico Oil Conservation Commission.
New York	New York State Geological Survey.
North Dakota	North Dakota Geological Survey.
Ohio	Ohio Department of Natural Resources.
Oklahoma	Oklahoma Corporation Commission and Oklahoma Tax Commission.
Pennsylvania	Pennsylvania Bureau of Topographic and Geologic Survey.
South Dakota	South Dakota Geological Survey.
Tennessee	Tennessee Department of Conservation.
Texas	The Railroad Commission of Texas.
Utah	Utah Oil and Gas Conservation Commission.
Virginia	Division of Mines and Quarries, Virginia Department of Labor and Industry.
West Virginia	West Virginia Department of Mines.
Wyoming	Wyoming State Oil and Gas Conservation Commission.

Table 6.—Supply and disposition of crude petroleum (including lease condensate) in the United States

(Thousand barrels)

Supply and disposition	1970	1971	1972	1973	1974 [p]
Supply:					
Production	3,517,450	3,453,914	3,455,368	3,360,903	3,202,585
Imports [1]	483,293	613,417	811,135	1,183,996	1,269,155
Total new supply	4,000,743	4,067,331	4,266,503	4,544,899	4,471,740
Stock changes: [2]					
Domestic crude oil	+10,380	−23,289	−17,064	−9,964	+13,758
Foreign crude oil	+760	+6,520	+3,811	+6,047	+8,784
Crude oil unaccounted for [3]	−7,721	+14,823	+10,201	+918	−9,084
Disposition by use:					
Runs of domestic crude oil	3,485,332	3,481,543	3,473,380	3,359,946	3,168,596
Runs of foreign crude oil	482,171	606,266	806,983	1,177,308	1,260,130
Exports [4]	4,991	503	187	697	1,074
Transfers:					
Distillate	743	1,548	944	760	774
Residual	4,317	4,565	3,822	6,126	4,751
Losses	4,328	4,448	4,641	4,897	4,789
Total disposition by use	3,981,882	4,098,873	4,289,957	4,549,734	4,440,114

[p] Preliminary.

[1] Bureau of Mines data.

[2] Minus sign represents withdrawal from stock; plus sign represents stock increase.

[3] Represents the difference between supply and indicated demand for crude petroleum.

[4] U.S. Department of Commerce data.

Table 7.—Percentage of total U.S. crude petroleum produced, by State

State	1970	1971	1972	1973	1974
Texas	35.5	35.4	37.7	38.5	39.4
Louisiana	25.8	27.1	25.8	24.7	23.0
California	10.6	10.4	10.0	10.0	10.1
Oklahoma	6.4	6.2	6.0	5.7	5.5
Wyoming	4.6	4.3	4.0	4.2	4.4
New Mexico	3.6	3.4	3.2	3.0	3.1
Alaska	2.4	2.3	2.1	2.2	2.2
Kansas	2.4	2.3	2.1	2.0	1.9
Mississippi	1.8	1.9	1.8	1.7	1.6
Utah	.7	.7	.8	1.0	1.2
Colorado	.7	.8	.9	1.1	1.2
Florida	.1	.2	.5	1.0	1.1
Montana	1.1	1.0	1.0	1.0	1.1
Illinois	1.2	1.1	1.0	.9	.9
North Dakota	.6	.6	.6	.6	.6
Michigan	.3	.3	.4	.4	.6
Arkansas	.5	.5	.5	.5	.5
Alabama	.2	.2	.3	.3	.4
Ohio	.3	.2	.3	.3	.3
Other States	1.2	1.1	1.0	.9	.9
Total	100.0	100.0	100.0	100.0	100.0

Table 8.—Well completions in the United States, by quarter[1]

	1st quarter	2d quarter	3d quarter	4th quarter	Total	
					Number	Percent
1973:[r]						
Oil	2,477	2,221	2,500	2,704	9,902	37.2
Gas[2]	1,395	1,332	1,661	1,997	6,385	24.0
Dry	2,555	2,217	2,512	3,021	10,305	38.8
Total	6,427	5,770	6,673	7,722	26,592	100.0
1974:						
Oil	2,590	3,152	3,417	3,625	12,784	40.3
Gas[2]	1,805	1,802	1,622	2,011	7,240	22.9
Dry	2,584	2,743	2,914	3,433	11,674	36.8
Total	6,979	7,697	7,953	9,069	31,698	100.0

[r] Revised.

[1] Excludes service wells. Data by quarters adjusted to agree with annual totals.

[2] Includes condensate wells.

Source: American Petroleum Institute.

Table 9.—Well completions in the United States, by State[1]

State	1973				1974			
	Oil	Gas[2]	Dry	Total	Oil	Gas[2]	Dry	Total
Alabama	18	10	74	102	16	16	66	98
Alaska	20	3	11	34	27	4	7	38
Arizona	--	1	7	8	3	--	8	11
Arkansas	91	40	154	285	99	41	177	317
California	879	65	263	1,207	1,567	69	314	1,950
Colorado	228	148	464	840	218	201	417	836
Florida	24	--	43	67	9	--	36	45
Georgia	--	--	3	3	--	--	5	5
Idaho	--	--	6	6	--	--	2	2
Illinois	240	13	303	556	357	11	427	795
Indiana	67	8	164	239	136	21	219	376
Iowa	--	--	--	--	--	--	2	2
Kansas	592	384	1,077	2,053	989	389	1,312	2,690
Kentucky	158	157	316	631	195	127	336	658
Louisiana:								
North	234	269	318	821	326	458	387	1,171
South	337	284	564	1,185	283	190	465	938
Offshore	287	231	380	898	216	141	304	661
Total Louisiana	858	784	1,262	2,904	825	789	1,156	2,770
Maryland	--	--	--	--	--	1	1	2
Michigan	73	41	164	278	116	52	234	402
Mississippi	70	28	252	350	67	26	349	442
Missouri	--	--	9	9	7	2	23	32
Montana	46	123	473	642	60	145	467	672
Nebraska	33	--	130	163	40	5	185	230
Nevada	--	--	--	--	--	--	2	2
New Mexico:								
West	57	372	76	505	53	252	63	368
East	223	126	196	545	297	211	252	760
Total New Mexico	280	498	272	1,050	350	463	315	1,128
New York	97	27	24	148	153	98	41	292
North Carolina	--	--	--	--	--	--	11	11
North Dakota	40	--	82	122	42	--	85	127
Ohio	393	940	171	1,504	567	1,050	171	1,788
Oklahoma	898	539	844	2,281	1,149	744	1,164	3,057
Oregon	--	--	3	3	--	--	--	--
Pennsylvania	525	484	90	1,099	671	468	69	1,208
South Dakota	5	--	17	22	1	--	10	11
Tennessee	24	10	64	98	61	12	62	135
Texas:								
District 01	179	58	278	515	252	96	207	555
District 02	79	176	224	479	77	290	312	679
District 03	292	138	402	832	369	162	412	943
District 04	146	272	320	738	230	326	320	876
District 05	3	12	63	78	33	15	90	138
District 06	116	54	117	287	88	71	135	294
District 07B	323	96	447	866	444	183	542	1,169
District 07C	357	265	234	856	414	282	225	921
District 08	977	98	189	1,264	1,058	127	164	1,349
District 08A	667	24	156	847	619	25	193	837
District 09	433	80	357	870	626	100	401	1,127
District 10	107	182	105	394	191	145	142	478
Offshore	7	20	45	72	1	21	141	163
Total Texas	3,686	1,475	2,937	8,098	4,402	1,843	3,284	9,529
Utah	104	25	66	195	118	12	65	195
Virginia	--	7	2	9	--	55	6	61
West Virginia	72	514	115	701	121	556	102	779
Wyoming	381	61	443	885	418	40	530	988
Gulf of Mexico Northern[3]	--	--	--	--	--	--	14	14
Total United States	9.902	6.385	10 305	26,592	12,784	7,240	11,674	31,698

[1] Excludes service wells.

[2] Includes condensate wells.

[3] Gulf of Mexico Northern is a new area designated by the Bureau of Land Management for Federally controlled Outer Continental Shelf (OCS) waters not previously mapped or leased. The area covers the Gulf of Mexico OSC waters off the States of Texas, Louisiana, Mississippi, Alabama, and Florida.

Source: American Petroleum Institute.

Table 10.—Producing oil wells in the United States and average production per well per day, by State

State	1973		1974	
	Approximate number of oil wells producing Dec. 31	Average production per well per day[1] (barrels)	Approximate number of oil wells producing Dec. 31	Average production per well per day[1] (barrels)
Alabama	586	56.6	582	62.5
Alaska	192	1,029.3	199	989.4
Arizona	28	78.7	25	76.5
Arkansas	7,232	6.9	7,235	6.3
California:				
South	8,812	39.0	8,923	38.8
Central coastal	5,762	38.7	6,022	35.2
East central	23,991	14.2	25,468	13.4
North	61	32.2	66	23.6
Total or average, California	38,626	23.6	40,479	22.4
Colorado	2,004	51.4	2,174	49.2
Florida	147	619.9	136	703.8
Illinois	24,309	3.4	23,630	3.1
Indiana	[2]4,323	3.3	[2]4,376	3.1
Kansas	41,520	4.4	[2]41,755	4.1
Kentucky	14,416	1.6	14,127	1.5
Louisiana:				
Gulf coast	[2]13,086	162.4	[2]12,858	147.5
Northern	[2]14,783	7.5	[2]15,115	7.1
Total or average, Louisiana	[2]27,869	81.9	[2]27,973	72.3
Michigan	3,733	10.8	4,201	12.4
Mississippi	2,901	50.4	2,254	54.0
Montana	3,471	27.0	3,103	28.8
Nebraska	1,107	17.6	1,127	16.2
New Mexico:				
Southeastern	15,503	16.4	12,274	17.9
Northwestern	1,596	13.0	1,030	16.7
Total or average, New Mexico	17,099	16.1	13,304	17.8
New York	5,200	.5	[2]5,475	.5
North Dakota	1,404	39.5	[2]1,488	37.3
Ohio	15,236	1.6	16,658	1.6
Oklahoma	72,880	7.1	71,797	6.7
Pennsylvania	31,539	.3	32,095	.3
South Dakota	27	26.9	31	46.7
Texas:				
District 01	9,851	5.7	10,320	5.2
District 02	4,589	44.6	4,488	43.2
District 03	9,610	47.6	9,769	49.5
District 04	6,680	23.3	7,103	20.5
District 05	2,400	35.3	2,557	23.2
District 06, except East Texas	4,974	42.9	5,059	46.3
East Texas	13,500	15.1	13,207	14.8
District 07B	10,203	9.3	10,179	9.7
District 07C	7,366	14.7	7,449	11.5
District 08	35,489	21.5	35,895	21.1
District 08A	17,126	55.0	17,493	57.3
District 09	25,514	4.7	24,579	4.6
District 10	11,788	5.1	11,604	5.0
Total or average, Texas	159,090	21.7	159,702	21.7
Utah	989	95.2	[2]1,076	104.4
West Virginia	[2]13,600	.5	[2]13,650	.5
Wyoming	7,642	46.9	[2]8,656	47.1
Other States:				
Missouri	135	1.2	157	1.1
Nevada	6	43.8	9	47.1
Tennessee	67	7.9	154	19.1
Virginia	--	--	3	5.5
Total or average	208	4.6	323	9.9
Total or average, United States	497,378	18.3	497,631	17.6

[1] Based on the average number of wells during the year.

[2] Estimated by Bureau of Mines; all other numbers of producing oil wells furnished by State agencies.

Table 11.—Production and reserves of crude petroleum in leading fields in the United States

(Thousand barrels)

Field[1]	State	Production		Total since discovery[2]	Estimated reserves
		1973	1974		
Wasson	Texas	83,726	86,784	703,095	629,453
Kelly-Snyder	do	70,944	76,433	616,472	491,640
East Texas	do	75,436	72,312	4,241,715	1,758,285
Wilmington	California	67,066	65,382	1,681,810	697,935
Slaughter	Texas	45,486	47,033	595,465	194,535
Hawkins	do	39,513	39,680	535,697	289,303
McArthur River	Alaska	39,171	39,191	253,387	186,748
Sho-Vel-Tum	Oklahoma	33,320	34,250	1,002,456	247,544
Jay	Florida	27,977	33,166	75,383	237,617
Bay Marchand Block 2	Louisiana	32,561	32,632	429,534	220,466
Hastings, East and West	Texas	22,546	27,912	502,991	172,009
Kern River	California	27,973	26,765	635,757	850,000
Tom O'Connor	Texas	27,895	25,667	496,410	203,590
Webster	do	20,894	24,762	412,958	162,042
West Delta Block 30	Louisiana	24,626	22,586	312,462	137,538
Greater Altamont	Utah	13,069	21,898	46,197	228,435
Conroe	Texas	21,846	21,737	540,659	134,341
Grand Isle Block 43	Louisiana	20,732	20,999	163,669	206,403
Rangely	Colorado	19,378	20,284	513,615	158,379
Seminole All	Texas	15,475	20,102	219,347	96,653
Eugene Island Block 330	Louisiana	(3)	19,747	40,488	190,754
Huntington Beach	California	20,389	19,035	923,820	118,800
Yates	Texas	18,195	18,192	605,446	994,556
Spraberry Trend	do	20,383	18,190	379,633	130,367
Caillou Island	Louisiana	25,613	18,023	516,898	133,102
Goldsmith All	Texas	19,298	17,431	578,658	96,342
Cowden South (Foster, Johnson)	do	16,075	16,714	299,613	100,387
Thompson (all fields)	do	15,858	16,319	370,071	129,929
Van and Van Shallow	do	16,658	16,264	419,384	130,616
South Pass Block 24	Louisiana	16,740	15,223	371,476	118,524
Dos Cuadras	California	16,745	14,990	102,488	73,247
Cowden North	Texas	13,091	14,954	276,820	48,180
West Ranch	do	(3)	14,560	76,469	298,531
Fairway	do	17,175	13,741	123,703	76,284
Salt Creek	Wyoming	15,203	13,284	542,518	82,113
Grand Isle Block 16	Louisiana	18,936	13,156	211,052	138,948
Vacuum	New Mexico	4,216	13,152	274,986	125,014
Salt Creek	Texas	12,014	13,093	126,663	103,337
San Ardo	California	12,609	12,877	274,160	103,800
Levelland	Texas	11,201	12,391	282,508	92,492
Panhandle	do	12,579	12,347	1,283,585	131,415
Empire Abo	New Mexico	9,797	12,267	111,171	88,829
McElroy	Texas	10,772	11,820	309,518	50,482
South Pass Block 27	Louisiana	13,366	11,568	258,926	126,074
Ventura	California	11,022	11,393	793,898	88,500
Oregon Basin	Wyoming	11,392	11,354	240,315	79,651
Ship Shoal Block 208	Louisiana	11,262	10,559	92,506	132,494
Main Pass Block 41	do	14,808	10,396	144,519	135,481
Cogdell Area	Texas	12,255	10,287	187,918	132,082
South Pass Block 65	Louisiana	12,088	10,105	46,193	143,807
West Delta Block 58	do	8,176	10,035	38,091	111,909
Sooner Trend	Oklahoma	11,480	9,810	199,414	50,586
Swanson River	Alaska	10,059	9,741	154,297	51,197
Timbalier Bay Block 21	Louisiana	9,456	9,449	159,698	100,111
Bell Creek	Montana	7,967	9,345	68,819	47,126
Middle Ground Shoal	Alaska	10,259	9,033	87,695	97,000
Anahuac	Texas	10,969	8,949	248,759	106,241
Elk Basin	Montana and Wyoming	9,559	8,887	448,442	69,759
Belridge South	California	8,558	8,544	194,803	77,900
Garden Island Bay	Louisiana	10,384	8,403	174,829	81,508
Golden Trend	Oklahoma	9,875	8,135	402,011	97,989
Eugene Island Block 175	Louisiana	9,873	8,059	37,300	82,700
Timbalier Bay	do	9,456	7,985	234,619	192,126
Main Pass Block 69	do	10,924	7,973	191,010	68,990
Greater Aneth	Utah	7,814	7,927	259,554	55,558
W. Cote Blanche Bay	Louisiana	10,288	7,880	147,316	102,684
West Delta Block 73	do	9,348	7,654	128,219	146,781
Healdton	Oklahoma	6,880	7,575	294,240	25,760
Dune	Texas	9,181	7,448	126,476	73,524
Anton	do	5,164	7,443	78,354	81,646
Hilight	Wyoming	7,896	7,358	48,299	85,552
Black Bay West	Louisiana	8,036	7,068	91,538	58,462

[1] Fields under 7 million barrels not shown for current year.
[2] Includes revisions, if any.
[3] Not reported.

Source: Oil and Gas Journal. All figures are preliminary.

Table 12.—Production, reserves, and undiscovered recoverable resources of crude oil for the United States, December 31, 1974 [1]

(Billion barrels)

Area	Cumulative production	Reserves			Range of undiscovered recoverable resources [2]
		Demonstrated		Inferred [3]	
		Measured [4]	Indicated [5]		
Lower 48 States, onshore	99.892	21.086	4.315	14.3	29–64
Alaska, onshore	.154	9.944	.013	6.1	6–19
Total onshore	100.046	31.030	4.328	20.4	37–81
Lower 48 States, offshore	5.634	3.070	.308	2.6	5–18
Alaska, offshore	.456	.150	([6])	.1	3–31
Total offshore	6.090	3.220	.308	2.7	10–49
Grand total	106.136	34.250	4.636	23.1	50–127

[1] Onshore and offshore to a water depth of 200 meters (656 feet). Cumulative production and estimates of reserves and resources reflect an assumed recovery of about 32% of the oil. Some portion of the remaining oil-in-place is recoverable through application of improved recovery techniques. Estimates are based on figures released by API in April 1975.

[2] The low value of the range is the quantity associated with a 95% probability (19-in-20 chance) that there is at least this amount. The high value is the quantity with a 5% probability (1-in-20 chance) that there is at least this amount. Totals for the low and high values are not obtained by arithmetic summation; they are derived by statistical methods.

[3] Resources estimated to be recoverable in the future as a result of extensions, revisions of estimates, and new pays in known fields beyond those shown in indicated reserves.

[4] Identified resources that can be economically extracted with existing technology. Estimates are the "proved reserves" of API.

[5] Identified resources, economically recoverable if known fluid-injection technology is applied. Estimates are from APL.

[6] Negligible.

Source: Derived from table 1, U.S. Geol. Survey Circ. 725.

Table 13.—Estimates of proved crude oil reserves in the United States on December 31, by State[1]

(Million barrels)

State	1970	1971	1972	1973	1974
Eastern States:					
Illinois	229	209	175	152	160
Indiana	37	31	29	27	24
Kentucky	61	52	48	40	37
Michigan	46	59	62	72	82
New York	11	10	9	8	11
Ohio	128	129	127	125	124
Pennsylvania	51	47	37	40	50
West Virginia	53	52	34	32	32
Total	616	589	521	496	520
Central and southern States:					
Alabama	65	61	57	54	69
Arkansas	130	118	113	106	106
Florida	(2)	204	208	184	303
Kansas	539	502	453	401	395
Louisiana[3]	5,710	5,399	5,029	4,577	4,227
Mississippi	355	342	313	291	261
Nebraska	41	36	31	28	27
New Mexico	761	657	583	648	625
North Dakota	192	174	166	179	173
Oklahoma	1,351	1,405	1,303	1,271	1,232
Texas[3]	13,195	13,028	12,144	11,757	11,002
Total	22,339	21,921	20,400	19,491	18,420
Mountain States:					
Colorado	389	333	326	305	289
Montana	242	228	241	219	207
Utah	182	166	244	264	251
Wyoming	1,017	997	950	917	903
Total	1,830	1,724	1,761	1,705	1,650
Pacific coast States:					
Alaska	10,149	[4]10,116	[4]10,096	[4]10,112	10,094
California[3]	3,984	3,706	3,554	3,488	3,557
Total	14,133	13,822	13,650	13,600	13,651
Other States[5]	83	7	7	8	9
Total United States	39,001	38,063	36,339	35,300	34,250

[1] From reports of Committee of Petroleum Reserves, American Petroleum Institute. Included are estimated quantities of crude oil that geological and engineering data demonstrate with reasonable certainty to be recoverable from known reservoirs under existing economic and operating conditions.

[2] Included with "Other States."

[3] Includes offshore reserves.

[4] These data include the estimate of proved reserves in the Prudhoe Bay Permo-Triassic reservoir, discovered in 1968. The estimate is based on the analysis of extensive engineering and geologic data; however, revisions may be required when actual production performance becomes available.

[5] Includes Arizona, Missouri, Nevada, South Dakota, Tennessee, and Virginia.

Table 14.—Supply, demand, and stocks change of refined products, 1974

(Thousand barrels per day)

	PAD district						United States
	I	II	III	IV	I–IV	V	
Supply:							
Refinery output	1,563	3,463	5,281	433	10,740	1,976	12,716
Natural gas liquids output	24	249	1,336	47	1,656	32	1,688
Unfinished oil reruns	−91	5	9	−3	−80	−22	−102
Other hydrocarbons and crude transfers	2	5	23	2	32	19	51
Receipts from other districts:							
District I	--	164	2	--	--	--	--
District II	67	--	81	8	--	--	--
District III	2,687	656	--	33	--	74	--
District IV	--	25	15	--	--	70	--
District V	3	--	--	20	23	--	--
Imports	2,093	140	167	39	2,439	172	2,611
Total new supply	6,348	4,707	6,914	579	14,810	2,321	16,964
Stock change[1]	−7	+23	+87	--	+103	+14	+117
Total supply	6,355	4,684	6,827	579	14,707	2,307	16,847
Exports	17	10	99	--	126	92	218
Shipments to other districts:							
District I	--	67	2,687	--	--	3	--
District II	164	--	656	25	--	--	--
District III	2	81	--	15	--	--	--
District IV	--	8	33	--	--	20	--
District V	--	--	74	70	144	--	--
Domestic product demand	6,172	4,518	3,278	469	14,437	2,192	16,629

[1] Plus sign represents a stocks increase, which is subtracted from total new supply; minus sign represents a stocks decrease, which is added to total new supply.

Table 15.—Refinery receipts of domestic

(Thousand

Location of refineries receiving crude oil	Total receipts of domestic crude oil	Intra-state receipts	Interstate						
			District I total	District II					
				Ill., Ind., Mich.	Kans.	Ky., Ohio, Tenn.	Nebr., N. Dak., S. Dak.	Okla.	Total
District I:									
Delaware and Maryland	7,593	--	4,535	--	--	--	--	--	--
Florida, Georgia, Virginia	1,126	--	--	--	--	--	--	--	--
New Jersey	25,477	--	868	--	--	--	--	--	--
New York	3,436	--	--	1,720	--	--	--	124	1,844
Pennsylvania:									
East	26,269	--	1,853	--	--	--	--	143	143
West	15,153	3,723	1,313	1,161	202	5,004	--	2,131	8,498
West Virginia	5,659	2,130	--	--	--	3,529	--	--	3,529
Total	84,713	5,853	8,569	2,881	202	8,533	-	2,398	14,014
District II:									
Illinois	292,861	15,490	--	--	3,706	--	1,518	19,627	24,851
Indiana	127,388	1,855	--	2,544	3,348	469	6,294	10,306	22,961
Kansas	125,008	56,932	--	--	--	--	541	23,600	24,141
Kentucky and Tennessee	44,294	3,613	39	8,932	--	12	--	--	8,944
Michigan	27,182	12,231	--	101	--	--	--	--	101
Minnesota and Wisconsin	6,602	--	--	--	--	--	4,244	57	4,301
Missouri and Nebraska	31,692	--	--	--	374	--	141	2,817	3,332
North Dakota	14,542	13,168	--	--	--	--	--	--	--
Ohio:									
East	13,598	262	--	672	--	--	--	146	818
West	119,211	--	--	8,102	--	--	--	477	8,579
Oklahoma	167,193	117,493	--	--	3,517	--	--	--	3,517
Total	969,571	221,044	39	20,351	10,945	481	12,738	57,030	101,545
District III:									
Alabama	11,735	1,129	4,438	--	--	--	--	--	--
Arkansas	19,483	12,329		--	--	--	--	--	--
Louisiana	481,325	376,881	10,564	--	--	--	--	1,310	1,310
Mississippi	78,650	15,678	--	--	--	--	--	--	--
New Mexico	22,778	22,393	--	--	--	--	--	--	--
Texas	961,626	803,030	14,117	--	372	--	--	5,385	5,757
Total	1,575,597	1,231,440	29,119	--	372	--	--	6,695	7,067
District IV:									
Colorado	14,014	3,704	--	--	--	--	--	--	--
Montana	28,157	10,006	--	--	--	--	--	--	--
Utah	43,176	17,461	--	--	--	--	--	--	--
Wyoming	52,430	50,513	--	--	--	--	--	--	--
Total	137,777	81,684	--	--	--	--	--	--	--
District V:									
California	377,077	315,219	--	--	--	--	--	--	--
Other States	24,785	19,306	--	--	--	--	--	--	--
Total	401,862	334,525	--	--	--	--	--	--	--
Total United States	3,169,520	1,874,546	[1] 37,727	23,232	11,519	9,014	12,738	66,123	122,626
Daily average	8,684	5,136	103	64	31	25	35	181	336

[1] Includes receipts from: Florida, 36,375; New York, 891; **West Virginia, 461.**

[2] Includes receipts from: Alaska, 50,247; Arizona 80; California 2,010.

crude oil in 1974 by State and PAD district
barrels)

receipts from—											
District III					District IV					District V total	Total interstate receipts
Ala., Ark., Miss.	La.	N. Mex.	Tex.	Total	Colo.	Mont.	Utah	Wyo.	Total		
--	1,187	--	1,871	3,058	--	--	--	--	--	--	7,593
839	--	--	287	1,126	--	--	--	--	--	--	1,126
269	9,958	--	14,382	24,609	--	--	--	--	--	--	25,477
--	1,272	--	320	1,592	--	--	--	--	--	--	3,436
1,281	1,112	--	21,880	24,273	--	--	--	--	--	--	26,269
--	938	--	321	1,259	--	360	--	--	360	--	11,430
--	--	--	--	--	--	--	--	--	--	--	3,529
2,389	14,467	--	39,061	55,917		360	--	--	360	--	78,860
9,293	65,036	43,749	113,505	231,583	3,494	2,608	613	14,222	20,937	--	277,371
--	16,253	8,933	48,043	73,229	363	14,435	-	14,545	29,343	--	125,533
--	--	--	18,537	18,537	2,873	1,065	1,392	20,068	25,398	--	68,076
324	25,289	--	5,348	30,961	--	--	--	737	737	--	40,681
--	5,976	--	--	5,976	--	--	--	8,874	8,874	--	14,951
--	136	--	548	684	--	1,617	--	--	1,617	--	6,602
--	--	2,112	23,768	25,880	--	80	--	2,400	2,480	--	31,692
--	--	--	--	--	--	1,374	--	--	1,374	--	1,374
--	7,271	--	4,377	11,648	--	--	--	870	870	--	13,336
3,062	42,062	1,259	58,466	104,849	--	115	141	5,527	5,783	--	119,211
--	--	1,587	44,104	45,691	--	50	233	209	492	--	49,700
12,679	162,023	57,640	316,696	549,038	6,730	21,344	2,379	67,452	97,905	--	748,527
6,156	--	--	12	6,168	--	--	--	--	--	--	10,606
--	1,021	--	6,133	7,154	--	--	--	--	--	--	7,154
17,497	--	--	75,073	92,570	--	--	--	--	--	--	104,444
--	62,972	--	--	62,972	--	--	--	--	--	--	62,972
--	--	--	--	--	234	--	145	--	379	6	385
9,643	109,981	13,983	2	133,609	1,707	--	3,406	--	5,113	--	158,596
33,296	173,974	13,983	81,220	302,473	1,941	--	3,551	--	5,492	6	344,157
--	--	--	--	--	--	573	2,370	7,367	10,310	--	10,310
--	--	--	--	--	--	--	--	18,151	18,151	--	18,151
--	--	--	--	--	21,445	--	--	4,270	25,715	--	25,715
--	--	--	--	--	1,209	361	347	--	1,917	--	1,917
--	--	--	--		22,654	934	2,717	29,788	56,093	--	56,093
--	--	280	564	844	1,444	--	12,019	--	13,463	47,551	61,858
--	--	--	--	--	--	--	699	--	699	4,780	5,479
--	--	280	564	844	1,444	--	12,718	--	14,162	52,331	67,337
48,364	350,464	71,908	437,541	908,272	32,769	22,638	21,365	97,240	174,012	[2] 52,337	1,294,974
132	960	197	1,199	2,488	90	62	59	266	477	144	3,548

Table 16.—Crude oil runs to stills and refinery receipts of crude oil in 1974

(Thousand barrels)

District and State	Crude oil input to refineries	Refinery fuel use and losses	By State of origin of domestic crude	Change in refinery stocks	Refinery receipts of domestic crude oil by receiving State and method of transportation						Refinery receipts of foreign crude	
					Interstate			Intrastate				
					Pipe-lines	Tank cars and trucks	Tankers and barges	Pipe-lines	Tank cars and trucks	Tankers and barges	Pipe-lines	Tankers and barges
District I:												
Delaware and Maryland	53,034	--	--	+478	--	--	--	--	--	7,593	--	45,919
Florida, Georgia, Virginia	21,927	5	36,375	+244	--	--	--	--	731	395	--	21,050
New Jersey and Rhode Island	188,896	93	--	−2,205	--	--	--	--	--	25,477	--	161,307
New York	32,161	--	891	+195	--	--	--	3,436	--	--	28,920	--
Pennsylvania:												
East	190,796	71	--	+165	--	--	--	--	--	26,269	1,922	162,841
West	21,828	6	3,723	−32	2,623	1,100	--	6,175	3,818	1,437	6,649	--
West Virginia	5,539	12	2,591	+108	2,043	87	--	1,837	718	974	--	--
Total	[1]514,181	187	43,580	−1,047	4,666	1,187	--	11,448	5,267	62,145	37,491	391,117
District II:												
Illinois	362,007	5	34,514	+419	15,382	108	--	277,371	--	--	69,570	--
Indiana	156,292	--	1,855	−171	1,728	127	--	122,628	471	2,434	28,733	--
Kansas	133,851	3	68,451	+201	55,867	1,065	--	66,629	1,447	--	9,047	--
Kentucky and Tennessee	62,082	29	4,112	−208	2,582	1,031	--	30,008	132	10,541	16,906	703
Michigan	43,255	17	16,439	−147	11,042	1,189	--	14,951	--	--	15,943	--
Minnesota and Wisconsin	64,261	7	--	+604	--	--	--	6,602	--	--	58,270	--
Missouri and Nebraska	31,899	--	6,174	−7	--	--	--	31,608	72	12	200	--
North Dakota and South Dakota	16,927	--	19,732	−32	13,023	145	--	1,330	44	--	2,353	--
Ohio:												
East	20,845	--	262	+121	262	--	--	13,336	--	--	7,368	--
West	[2]157,953	1	8,515	+503	--	--	--	119,211	--	--	[2]39,246	--
Oklahoma	167,166	5	183,616	+401	113.372	4,121	--	49,700	--	--	379	--
Total	1,216,538	67	343,670	+1,684	213,258	7,786	--	733,374	2,166	12,987	248,015	703
District III:												
Alabama	11,876	125	12,783	+9	154	139	836	10,013	99	494	--	275
Arkansas	19,452	9	13,761	+22	11,602	727	--	7,051	103	--	--	--
Louisiana	535,220	121	727,345	+1,298	291,782	6,551	78,548	95,873	1,188	7,383	--	55.314
Mississippi	85,430	113	50,956	+452	14,064	1,614	--	62,972	--	--	--	7,345
New Mexico	22,417	27	94,296	+334	19,324	3,069	--	58	327	--	--	--
Texas	1,188,124	240	1,240,571	+327	775,101	13,012	14,917	80,901	494	77,201	1,156	225,909
Total	1,862,519	635	2,139,712	+2,442	1,112,027	25,112	94,301	256,868	2,211	85,078	1,156	288,843
District IV:												
Colorado	14,393	--	36,478	−30	2,254	1,450	--	7,940	2,370	--	349	--
Montana	40,771	16	32,644	+260	9,129	877	--	18,151	--	--	[3]12,890	--
Utah	43,008	36	38,826	+132	13,030	4,431	--	23,631	2,084	--	--	--
Wyoming	55,271	1	147,753	+192	49,330	1,183	--	1,041	876	--	3,034	--
Total	153,443	53	255,696	+554	73,743	7,941	--	50,763	5,330	--	16,278	--

District V:												
California	541,548	328	317,229	+1,856	269,871	9,306	36,042	8,988	6,330	46,540	115	166,540
Other States [4]	140,497	70	69,633	+761	18,893	346	67	--	699	4,780	67,604	48,939
Total	682,045	398	386,862	+2,617	288,764	9,652	36,109	8,988	7,029	51,320	67,719	215,479
Total United States	4,428,726	1,340	3,169,520	+6,250	1,692,458	51,678	130,410	1,061,441	22,003	211,530	[5] 370,654	896,142
Daily average	12,133	4	8,684	+17	4,637	142	357	2,908	60	580	1,015	2,455

[1] Includes 271,342,000 barrels in Delaware River Valley.

[2] Includes some Athabasca hydrocarbons.

[3] Includes 145 by truck.

[4] Alaska, Arizona, Hawaii, Nevada, Oregon, and Washington.

[5] Excludes crude oil imported for direct burning for fuel use by pipeline.

Table 17.—Supply and distribution of crude oil, 1974

(Thousand barrels per day)

	PAD districts						United States
	I	II	III	IV	I–IV	V	
Crude oil supply:							
Domestic production including lease condensate	119	916	5,969	689	7,693	1,081	8,774
Receipts from other districts:							
District I	--	--	80	--	--	--	--
District II	38	--	19	--	--	--	--
District III	153	1,504	--	--	--	2	--
District IV	1	268	15	--	--	39	--
District V	--	--	--	--	--	--	--
Imports	1,174	687	795	45	2,701	776	3,477
Total new supply	1,485	3,375	6,878	734	10,394	1,898	12,251
Stocks change[1]	−3	+33	+5	+7	+42	+20	+62
Total supply	1,488	3,342	6,873	727	10,352	1,878	12,189
Crude oil distribution:							
Crude runs to stills	1,408	3,333	5,103	420	10,264	1,869	12,133
Transfers to products	--	2	5	1	8	7	15
Shipments to other districts:							
District I	--	38	153	1	--	--	--
District II	--	--	1,504	268	--	--	--
District III	80	19	--	15	--	--	--
District IV	--	--	--	--	--	--	--
District V	--	--	2	39	41	--	--
Exports	--	--	3	--	3	--	3
Losses	2	1	8	1	12	1	13
Crude oil unaccounted for	2	51	−95	18	−24	−1	−25

[1] Plus sign represents a stocks increase, which is subtracted from total supply; minus sign represents a stocks decrease, which is added to total new supply.

Table 18.—Supply and disposition of crude petroleum (including lease condensate) in the United States, by month

(Thousand barrels)

Supply and disposition	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
1973													
Supply:													
Production	284,454	263,066	287,430	278,757	287,134	276,418	285,731	284,225	271,959	285,940	274,829	280,960	3,360,903
Imports [1]	84,693	80,433	98,021	91,459	99,654	96,613	108,530	111,368	104,117	115,905	103,570	89,633	1,183,996
Total new supply	369,147	343,499	385,451	370,216	386,788	373,031	394,261	395,593	376,076	401,845	378,399	370,593	4,544,899
Change in stocks, end of period:													
Domestic crude	−8,435	−2,058	+5,849	+4,663	+8,460	−6,452	−9,188	+609	−4,009	+2,016	+999	−2,418	−9,964
Foreign crude	−491	−49	+2,920	−11	+624	−2,558	+4,004	+4,032	−3,029	+3,005	+2,702	−5,102	+6,047
Crude oil unaccounted for [2]	+612	−3,637	+2,352	+1,466	+3,924	+5,041	−2,979	+2,046	−5,121	−110	−2,337	−339	+918
Disposition by use:													
Runs of domestic crude	292,755	260,792	283,168	274,790	281,760	286,783	290,839	284,383	269,706	282,613	270,389	281,968	3,359,946
Runs of foreign crude	85,148	80,452	95,053	91,449	98,942	99,086	104,397	107,316	107,083	112,878	100,885	94,669	1,177,308
Exports [3]	--	--	--	--	128	--	232	--	160	--	--	177	697
Transfers:													
Distillate	44	42	76	69	67	68	81	64	69	76	46	58	760
Residual	330	312	329	326	320	729	492	813	568	722	690	495	6,126
Losses	408	371	408	396	411	416	425	422	407	425	401	407	4,897
Total disposition by use	378,685	341,969	379,084	367,030	381,628	387,082	396,466	392,998	377,993	396,714	372,361	377,774	4,549,734
1974 p													
Supply:													
Production	276,950	255,982	277,927	268,619	276,228	263,407	272,184	269,665	253,288	266,949	257,064	264,322	3,202,585
Imports [1]	73,839	62,940	76,329	98,011	121,139	117,747	126,835	121,634	113,907	118,096	118,739	119,939	1,269,155
Total new supply	350,789	318,922	354,256	366,630	397,367	381,154	399,019	391,299	367,195	385,045	375,803	384,261	4,471,740
Change in stocks, end of period:													
Domestic crude	−4,892	+8,572	+4,044	+6,498	+5,539	−1,677	+359	−2,984	−1,480	+6,751	−412	−6,560	+13,758
Foreign crude	−4,551	−884	−102	+5,222	+7,531	+987	−438	−862	+3,366	−4,040	+2,119	+436	+8,784
Crude oil unaccounted for [2]	−2,532	+714	+2,484	+607	−918	−33	−1,109	−2,324	−784	−597	−3,148	−1,444	−9,084
Disposition by use:													
Runs of domestic crude	277,845	247,059	275,625	261,981	268,734	264,162	269,877	269,506	253,147	258,750	253,353	268,607	3,168,596
Runs of foreign crude	78,361	63,804	76,388	92,758	113,597	116,750	127,265	122,472	110,564	122,104	116,595	119,477	1,260,130
Exports [3]	534	281	--	15	200	44	--	--	--	--	--	--	1,074
Transfers:													
Distillate	61	56	52	55	72	89	62	70	63	74	55	65	774
Residual	513	407	356	378	364	355	358	351	357	398	545	374	4,751
Losses	386	341	382	385	412	411	427	422	394	411	400	418	4,789
Total disposition by use	357,700	311,948	352,798	355,517	383,379	381,811	397,989	392,821	364,525	381,737	370,948	388,941	4,440,114

p Preliminary except for crude petroleum production.

[1] Reported to the Bureau of Mines. Imports of crude oil include some Athabasca hydrocarbons.

[2] Represents the difference between supply and indicated demand for crude petroleum.

[3] U.S. Department of Commerce.

Table 19.—Input and output of petroleum products at refineries in the United States

(Thousand barrels)

	1970	1971	1972	1973	1974 p
INPUT					
Crude petroleum:					
Domestic	3,485,332	3,481,543	3,473,880	3,359,946	3,168,596
Foreign [1]	482,171	606,266	806,983	1,177,308	1,260,130
Total crude petroleum	3,967,503	4,087,809	4,280,863	4,537,254	4,428,726
Unfinished oils rerun (net)	+38,091	+43,608	+51,518	+45,768	+37,351
Total crude and unfinished oils rerun	4,005,594	4,131,417	4,332,381	4,583,022	4,466,077
Natural gas liquids:					
Liquefied petroleum gases	80,307	79,695	85,193	80,221	80,217
Natural gasoline	163,976	166,222	164,062	160,350	147,603
Plant condensate	34,051	39,020	53,190	56,911	44,596
Total natural gas liquids	278,334	284,937	302,445	297,482	272,416
Other hydrocarbons and hydrogen [2]	6,238	6,074	10,118	10,716	13,057
OUTPUT					
Gasoline:					
Motor gasoline [3]	2,080,199	2,179,093	2,298,775	2,382,418	2,320,488
Aviation gasoline	19,712	18,457	16,993	16,413	15,895
Total gasoline [3]	2,099,911	2,197,550	2,315,768	2,398,831	2,336,383
Jet fuel:					
Naphtha-type [3]	84,060	85,317	76,565	65,997	71,175
Kerosine-type	217,832	219,348	233,464	247,692	233,889
Total jet fuel [3]	301,892	304,665	310,029	313,689	305,064
Ethane (including ethylene)	9,460	9,266	9,197	9,194	6,330
Liquefied refinery gas:					
For fuel use	80,870	88,648	84,514	89,570	81,561
For chemical use	35,657	32,304	36,668	38,062	35,433
Total liquefied refinery gas	116,527	120,952	121,182	127,632	116,994
Kerosine [3]	94,635	86,256	79,027	79,422	56,646
Distillate fuel oil [3]	895,656	910,727	962,405	1,029,343	973,764
Residual fuel oil	257,510	274,684	292,519	354,597	390,491
Petrochemical feedstocks:					
Still gas	12,564	16,158	14,678	12,428	14,375
Naphtha—400°	54,154	54,096	57,027	57,155	62,568
Other	33,663	40,694	52,321	62,981	57,821
Total petrochemical feedstocks	100,381	110,948	124,026	132,564	134,764
Special naphthas [3]	30,196	28,255	32,096	32,873	33,362
Lubricants	66,183	65,473	65,349	68,742	70,694
Wax (280 pounds = 1 barrel)	6,294	6,939	6,148	6,768	6,929
Coke (1 short ton = 5.0 barrels)	107,871	109,114	119,765	132,290	123,746
Asphalt (1 short ton = 5.5 barrels)	146,658	157,039	155,294	167,884	164,237
Road oil	9,393	8,755	7,943	7,326	7,162
Still gas for fuel	163,905	156,967	170,993	176,758	175,724
Miscellaneous [3]	14,746	14,271	15,364	18,795	24,515
Processing gain (−) or loss (+)	−131,052	−139,433	−142,161	−165,488	−175,255

p Preliminary.

[1] Includes some Athabasca hydrocarbons.

[2] "Other hydrocarbons and hydrogen" is defined as including all hydrogen, process natural gas, tar sand bitumen, gilsonite, shale oils, and other naturally occurring hydrocarbon mixtures consumed as raw materials in the production of finished products.

[3] Production at gas-processing plants shown as direct transfers and omitted from the input and output at refineries.

Table 20.—Input and output at refineries in the United States, by month
(Thousand barrels)

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
INPUT 1978													
Crude petroleum:													
Domestic	292,755	260,792	283,168	274,790	281,760	286,783	290,839	284,383	269,706	282,613	270,389	281,968	3,359,946
Foreign	85,148	80,452	95,053	91,449	98,942	99,086	104,397	107,316	107,083	112,878	100,835	94,669	[1]1,177,308
Total crude petroleum	377,903	341,244	378,221	366,239	380,702	385,869	395,236	391,699	376,789	395,491	371,224	376,637	4,537,254
Unfinished oils rerun (net)	+10,272	+2,663	−5,882	−2,524	+3,554	+6,431	+5,783	+7,897	+1,622	+2,993	+3,866	+9,093	+45,768
Total crude and unfinished oils rerun	388,175	343,907	372,339	363,715	384,256	392,300	401,019	399,596	378,411	398,484	375,090	385,730	4,583,022
Natural gas liquids:													
Liquefied petroleum gases	8,666	6,982	6,377	5,238	5,285	5,494	5,934	6,617	6,254	7,483	7,853	8,038	80,221
Natural gasoline	12,336	11,425	12,935	11,906	12,888	12,899	15,297	15,164	14,305	13,940	13,863	13,392	160,350
Plant condensate	5,009	4,988	5,183	4,837	4,549	4,306	5,087	4,819	4,433	4,460	4,574	4,666	56,911
Total natural gas liquids	26,011	23,395	24,495	21,981	22,722	22,699	26,318	26,600	24,992	25,883	26,290	26,096	297,482
Other hydrocarbons and hydrogen	856	942	1,000	700	989	846	978	948	905	895	749	908	10,716
OUTPUT 1978													
Gasoline:													
Motor gasoline [3]	196,571	171,940	190,648	191,315	208,147	209,792	216,572	213,277	198,580	205,249	191,259	189,068	2,382,418
Aviation gasoline	1,001	775	1,180	1,241	1,378	1,335	1,562	1,942	1,444	1,654	1,753	1,148	16,413
Total gasoline [3]	197,572	172,715	191,828	192,556	209,525	211,127	218,134	215,219	200,024	206,903	193,012	190,216	2,398,831
Jet fuel:													
Naphtha-type [3]	5,281	4,589	6,057	5,955	6,005	5,344	4,833	5,371	5,578	5,278	4,905	6,801	65,997
Kerosine-type	21,506	20,567	22,369	20,658	20,081	19,731	20,739	20,802	19,841	21,851	20,668	18,929	247,692
Total jet fuel [3]	26,787	25,156	28,426	26,613	26,086	25,075	25,572	26,173	25,419	27,129	25,573	25,780	313,689
Ethane (including ethylene)	722	659	786	687	892	849	842	898	717	713	759	720	9,194
Liquefied refinery gases:													
For fuel use	7,191	6,574	7,606	7,488	8,753	7,745	8,467	7,929	6,952	7,683	6,303	6,879	89,570
For chemical use	3,275	2,826	3,382	3,015	3,394	3,050	3,402	3,264	3,421	3,285	2,873	2,875	38,062
Total liquefied refinery gases	10,466	9,400	10,988	10,503	12,147	10,795	11,869	11,193	10,373	10,968	9,176	9,754	127,632
Kerosine [3]	9,446	9,290	7,931	6,507	5,093	4,486	4,874	5,392	5,849	6,963	6,553	7,038	79,422
Distillate fuel oil [3]	93,862	82,242	82,679	75,306	78,860	84,759	85,299	86,840	84,379	90,230	87,672	97,215	1,029,343
Residual fuel oil	34,472	29,053	29,592	26,315	29,392	27,448	27,352	26,368	26,338	30,517	31,840	35,910	354,597
Petrochemical feedstocks:													
Still gas	1,327	840	1,183	1,019	1,222	1,054	916	1,188	1,015	884	902	878	12,428
Naphtha-400°	4,780	4,751	4,509	4,815	3,943	4,329	4,655	4,648	4,816	5,106	5,066	5,737	57,155
Other	4,821	4,495	5,270	5,337	5,040	5,572	5,468	5,351	4,998	5,620	5,548	5,461	62,981
Total petrochemical feedstocks	10,928	10,086	10,962	11,171	10,205	10,955	11,039	11,187	10,829	11,610	11,516	12,076	132,564
Special naphthas [3]	2,742	2,320	2,802	2,499	2,697	2,673	3,126	2,867	2,720	2,977	2,628	2,822	32,878

See footnotes at end of table.

Table 20.—Input and output at refineries in the United States, by month—Continued

(Thousand barrels)

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
OUTPUT 1973													
Lubricants:													
Bright stock	572	520	708	652	609	558	705	571	546	669	606	770	7,481
Neutral	2,772	2,349	2,611	2,376	2,380	2,375	2,338	2,495	2,348	2,621	2,624	2,675	29,964
Other grades	2,396	2,546	2,555	2,457	2,783	2,477	2,749	2,534	2,566	2,881	2,792	2,561	31,297
Total lubricants	5,740	5,415	5,869	5,485	5,772	5,410	5,792	5,600	5,460	6,171	6,022	6,006	68,742
Wax (280 pounds=1 barrel):													
Microcrystalline	78	66	81	88	87	115	100	105	97	112	106	103	1,138
Crystalline-fully refined	280	189	231	254	298	250	231	282	279	294	327	288	3,203
Crystalline-other	178	159	222	176	188	174	231	187	182	240	250	245	2,432
Total wax	536	414	534	513	573	539	562	574	558	646	683	636	6,768
Coke (1 short ton=5.0 barrels)	11,412	10,061	11,135	10,875	11,146	11,574	11,755	11,546	10,335	11,077	10,497	10,877	132,290
Asphalt (1 short ton=5.5 barrels)	7,919	8,336	10,109	12,082	14,702	16,799	17,689	18,925	18,104	17,823	14,029	11,367	167,884
Road oil	192	192	476	555	662	1,046	999	1,117	890	678	305	214	7,326
Still gas for fuel	15,018	13,129	14,901	14,420	14,854	15,665	16,258	15,911	14,487	14,768	13,369	13,978	176,758
Miscellaneous products[3]	1,416	1,252	1,318	1,514	1,947	1,462	1,749	1,918	1,578	1,685	1,402	1,559	18,795
Processing gain (−) or loss (+)	−14,188	−11,476	−12,452	−11,205	−16,536	−14,817	−14,596	−14,579	−13,752	−15,596	−12,907	−13,384	−165,488
INPUT 1974[p]													
Crude petroleum:													
Domestic	277,845	247,059	275,625	261,931	268,784	264,162	269,877	269,506	253,147	258,750	253,353	268,607	3,168,596
Foreign	78,361	63,804	76,383	92,758	113,597	116,750	127,265	122,472	110,564	122,104	116,595	119,477	1,260,130
Total crude petroleum	356,206	310,863	352,008	354,689	382,331	380,912	397,142	391,978	363,711	380,854	369,948	388,084	4,428,726
Unfinished oils rerun (net)	+4,924	+6,100	−6,721	+3,803	−683	+1,662	+5,798	+7,303	+5,125	+1,852	+2,843	+5,345	+37,351
Total crude and unfinished oils rerun	361,130	316,963	345,287	358,492	381,648	382,574	402,940	399,281	368,836	382,706	372,791	393,429	4,466,077
Natural gas liquids:													
Liquefied petroleum gases	7,073	6,015	5,900	5,303	5,765	5,779	5,770	6,431	6,646	7,814	8,211	9,510	80,217
Natural gasoline	12,770	11,409	12,262	11,107	12,368	12,227	13,231	13,233	12,064	12,907	12,093	11,932	147,603
Plant condensate	4,765	4,326	4,158	4,302	2,898	3,519	3,408	3,325	3,439	3,697	3,539	3,220	44,596
Total natural gas liquids	24,608	21,750	22,320	20,712	21,031	21,525	22,409	22,989	22,149	24,418	23,843	24,662	272,416
Other hydrocarbons and hydrogen	977	1,123	751	1,200	1,174	1,203	1,246	1,505	1,005	903	994	976	13,057
OUTPUT 1974[p]													
Gasoline:													
Motor gasoline[3]	182,900	167,140	185,443	189,329	196,186	199,892	210,573	211,259	193,590	196,427	188,751	198,998	2,320,488
Aviation gasoline	1,120	973	1,010	1,075	1,477	1,444	1,567	1,684	1,934	1,301	1,290	1,020	15,895
Total gasoline[3]	184,020	168,113	186,453	190,404	197,663	201,336	212,140	212,943	195,524	197,728	190,041	200,018	2,336,383

Jet fuel:													
Naphtha-type [2]	5,453	4,859	6,661	6,128	6,850	6,427	5,183	5,162	6,482	6,118	6,497	5,355	71,175
Kerosine-type	19,341	17,066	19,122	19,919	20,059	17,869	19,678	19,790	19,533	20,783	19,388	21,341	233,889
Total jet fuel [2]	24,794	21,925	25,783	26,047	26,909	24,296	24,861	24,952	26,015	26,901	25,885	26,696	305,064
Ethane (including ethylene)	673	684	715	459	477	447	486	492	456	533	457	451	6,330
Liquefied refinery gases:													
For fuel use	6,497	5,878	6,561	7,229	7,539	7,322	7,586	7,381	6,819	6,479	6,006	6,264	81,561
For chemical use	2,956	2,875	3,280	2,902	2,514	3,280	3,222	3,320	3,167	3,204	2,556	2,157	35,433
Total liquefied refinery gases	9,453	8,753	9,841	10,131	10,053	10,602	10,808	10,701	9,886	9,683	8,562	8,421	116,994
Kerosine [2]	5,900	5,595	4.651	3,591	3,897	4,038	3,695	4,088	4,099	5,788	5,342	5,962	56,646
Distillate fuel oil [2]	89,287	67,166	69.014	75,655	83,838	83,485	86,547	83,852	76,546	83,696	84,019	90,659	973,764
Residual fuel oil	33,222	28,808	28,259	29,539	30,835	30,773	32,727	33,072	30,963	34.060	36,861	41,372	390,491
Petrochemical feedstocks:													
Still gas	1,263	877	799	795	889	1,282	1,184	1,308	1,298	1,464	1,246	2,020	14,375
Naphtha-400°	4,728	4,921	5,189	4,409	4,954	5,258	6,263	5,948	5,250	5,269	5,330	5,049	62,568
Other	4,176	4,675	4,242	4,192	4,176	4,660	5,567	5,447	5,087	5,301	5,363	4,935	57,821
Total petrochemical feedstocks	10,167	10,473	10,230	9,396	10,019	11,150	13.014	12,703	11,635	12,034	11,939	12,004	134,764
Special naphthas [2]	2,809	2,529	2,795	2,891	2,968	2,694	2,928	2,937	2,701	2.911	2.818	2,471	33,362
Lubricants:													
Bright stock	621	517	605	610	694	537	474	648	624	684	576	614	7,204
Neutral	2,661	2,319	2,757	2,586	2,570	2,695	2,621	2,676	2,670	2,592	2,676	2,540	31,363
Other grades	2,591	2,356	2,745	2,817	2,810	2,854	2,882	2,690	2,500	2,665	2,554	2,663	32,127
Total lubricants	5,873	5,192	6,107	6,013	6,074	6,086	5,977	6,014	5,794	5,941	5,806	5,817	70,694
Wax (280 pounds=1 barrel):													
Microcrystalline	90	90	103	103	105	93	95	98	84	104	82	89	1,136
Crystalline, fully refined	298	235	296	248	263	262	237	293	235	231	217	217	3,032
Crystalline, other	181	190	195	241	235	284	275	289	221	247	216	187	2,761
Total wax	569	515	594	592	603	639	607	680	540	582	515	493	6,929
Coke (1 short ton=5.0 barrels)	10,263	9,221	9,970	10,047	10,729	10,453	10,861	10,847	10,190	10,332	9,875	10,958	123,746
Asphalt (1 short ton=5.5 barrels)	8,802	8,668	11,504	13,058	14,696	16,135	17,622	17,286	15,626	16,786	13,266	10,788	164,237
Road oil	234	334	543	591	707	835	1,070	1,016	706	559	278	289	7,162
Still gas for fuel	13,833	12,543	13,285	14,472	14,835	15,616	16,869	16,545	14,220	14,981	14,217	14,308	175,724
Miscellaneous products [2]	1,669	1,426	1,566	1,862	2,398	2,156	2,418	2,303	1,890	2,215	2,264	2,358	24,515
Processing gain (−) or loss (+)	−14,853	−12,109	−12,952	−14,344	−12,848	−15,349	−16,030	−16,656	−14,901	582	515	493	6,929

[p] Preliminary.

[1] Includes some Athabasca hydrocarbons.

[2] Production at gas-processing plants shown as direct transfer and omitted from the input and output at refineries.

Table 21.—Input and output at refineries

(Thousand

	District I			District II				
	East coast	Appalachian No. 1	Total	Appalachian No. 2	Ind., Ill., etc.	Minn., Wis., etc.	Okla., Kans., etc.	Total
INPUT 1973								
Crude petroleum:								
Domestic	67,106	19,505	86,611	10,313	654,928	21,291	326,055	1,012,587
Foreign	417,100	44,316	461,416	9,625	[1]172,328	67,168	10,290	259,411
Total crude petroleum	484,206	63,821	548,027	19,938	827,256	88,459	336,345	1,271,998
Unfinished oils rerun (net)	+39,209	+282	+39,491	+99	+1,813	−63	−1,646	+203
Total crude and unfinished oils rerun	523,415	64,103	587,518	20,037	829,069	88,396	334,699	1,272,201
Natural gas liquids:								
Liquefied petroleum gases	148	127	275	--	11,948	2,973	11,784	26,705
Natural gasoline	147	6	153	--	4,854	2,717	11,944	19,515
Plant condensate	206	1,920	2,126	826	16,162	7,437	30	24,455
Total natural gas liquids	501	2,053	2,554	826	32,964	13,127	23,758	70,675
Other hydrocarbons and hydrogen	555	--	555	--	273	--	339	612
OUTPUT 1973								
Gasoline:								
Motor gasoline [2]	245,194	27,315	272,509	10,854	465,627	51,806	197,844	726,131
Aviation gasoline	423	--	423	--	1,595	--	520	2,115
Total gasoline [2]	245,617	27,315	272,932	10,854	467,222	51,806	198,364	728,246
Jet fuel:								
Naphtha-type [2]	1,907	819	2,726	--	5,738	981	5,218	11,937
Kerosine-type	11,223	695	11,918	--	38,671	1,490	10,627	50,788
Total jet fuel [2]	13,130	1,514	14,644	--	44,409	2,471	15,845	62,725
Ethane (including ethylene)	58	--	58	--	--	--	520	520
Liquefied refinery gases:								
For fuel use	12,952	1,412	14,364	367	16,638	1,301	7,017	25,323
For chemical use	6,394	--	6,394	--	2,571	221	1,456	4,248
Total liquefied refinery gases	19,346	1,412	20,758	367	19,209	1,522	8,473	29,571
Kerosine [2]	5,079	1,930	7,009	814	15,743	1,242	2,088	19,887
Distillate fuel oil [2]	130,868	16,135	147,003	4,674	182,761	24,612	85,749	297,796
Residual fuel oil	45,238	7,020	52,258	1,758	53,612	8,026	7,724	71,120
Petrochemical feedstocks:								
Still gas	919	23	942	--	2,128	--	543	2,671
Naphtha–400°	4,932	--	4,932	--	4,373	--	2,200	6,573
Other	30	738	768	--	2,304	--	553	2,857
Total petrochemical feedstocks	5,881	761	6,642	--	8,805	--	3,296	12,101
Special naphthas [2]	123	268	391	257	4,563	--	1,286	6,106
Lubricants:								
Bright stock	599	1,396	1,995	--	438	--	1,126	1,564
Neutral	3,302	2,727	6,029	--	3,258	--	2,705	5,963
Other grades	3,711	346	4,057	--	1,684	--	1,514	3,198
Total lubricants	7,612	4,469	12,081	--	5,380	--	5,345	10,725
Wax (280 pounds=1 barrel):								
Microcrystalline	89	282	371	--	1	--	293	294
Crystalline, fully refined	406	134	540	--	315	--	257	572
Crystalline, other	24	498	522	--	249	--	79	328
Total wax	519	914	1,433	--	565	--	629	1,194
Coke (1 short ton=5.0 barrels)	13,205	422	13,627	289	23,731	3,618	11,235	38,873
Asphalt (1 short ton=5.5 barrels)	34,339	2,077	36,416	1,688	33,460	7,517	14,972	57,637
Road oil	--	706	706	--	2,828	--	1,276	4,104
Still gas for fuel	20,618	2,084	22,702	669	31,770	1,476	12,318	46,233
Miscellaneous products [2]	2,106	172	2,278	53	1,571	10	1,291	2,925
Processing gain (−) or loss (+)	−19,263	−1,048	−20,311	−560	−33,323	−777	−11,615	−46,275

See footnotes at end of table.

in the United States, by PAD district
barrels)

District III						District IV	District V	
Tex. inland	Tex. gulf	La. gulf	Ark., La. inland, etc.	N. Mex.	Total	Other Rocky Mt.	West coast	United States
155,889	887,281	590,266	49,033	16,932	1,699,401	135,410	425,937	3,359,946
--	128,156	16,869	272	--	145,297	16,111	295,073	[1]1,177,308
155,889	1,015,437	607,135	49,305	16,932	1,844,698	151,521	721,010	4,537,254
−725	−22,501	+15,044	+624	+32	−7,526	+88	+13,512	+45,768
155,164	992,936	622,179	49,929	16,964	1,837,172	151,609	734,522	4,583,022
7,052	13,954	19,864	1,093	615	42,578	3,443	7,220	80,221
15,993	88,679	24,164	869	760	130,465	1,673	8,544	160,350
18	11,893	1,618	3,031	83	16,643	10,125	3,562	56,911
23,063	114,526	45,646	4,993	1,458	189,686	15,241	19,326	297,482
161	144	4,261	153	--	4,719	88	4,742	10,716
97,473	513,108	328,709	20,628	9,479	969,397	82,846	331,535	2,382,418
2,272	4,813	2,597	--	--	9,682	443	3,750	16,413
99,745	517,921	331,306	20,628	9,479	979,079	83,289	335,285	2,398,831
5,579	10,775	7,677	1,610	2,052	27,693	3,493	20,148	65,997
8,004	56,473	49,630	1	65	114,173	4,611	66,202	247,692
13,583	67,248	57,307	1,611	2,117	141,866	8,104	86,350	313,689
108	5,040	2,960	--	--	8,108	--	508	9,194
3,171	17,077	14,199	696	364	35,507	2,174	12,202	89,570
228	15,723	6,935	328	5	23,219	62	4,139	33,062
3,399	32,800	21,134	1,024	369	58,726	2,286	16,841	127,632
1,130	26,883	20,074	785	131	49,003	2,204	1,319	79,422
31,189	244,178	149,311	11,700	3,601	439,979	41,966	102,599	1,029,343
5,695	53,075	23,755	4,764	1,166	88,455	9,864	132,900	354,597
432	7,341	--	--	--	7,773	161	881	12,428
1,768	38,041	489	--	--	40,298	--	5,352	57,155
3,578	26,135	26,236	241	--	56,190	34	3,132	62,981
5,778	71,517	26,725	241	--	104,261	195	9,365	132,564
1,425	17,716	266	1,603	--	21,010	125	5,241	82,878
--	1,932	662	--	--	2,594	44	1,284	7,481
--	8,577	6,039	851	--	15,467	176	2,329	29,964
108	19,612	1,185	1,133	--	22,038	167	1,837	31,297
108	30,121	7,886	1,984		40,099	387	5,450	68,742
79	145	42	194	--	460	8	--	1,133
--	605	744	--	--	1,349	56	686	3,203
--	1,127	146	--	--	1,273	34	275	2,432
79	1,877	932	194	--	3,082	98	961	6,768
3,313	23,718	14,578	640	187	42,436	3,988	33,371	132,290
7,570	9,426	14,731	8,896	810	41,433	10,385	22,018	167,884
64	--	--	--	--	64	770	1,682	7,826
5,837	39,747	22,586	1,373	528	70,071	5,471	82,281	176,758
2,030	5,507	3,187	246	--	10,970	108	2,519	18,795
−2,665	−39,168	−24,652	−614	+34	−67,065	−2,242	−29,595	−165,488

Table 21.—Input and output at refineries in the

(Thousand

	District I			District II				
	East coast	Appalachian No. 1	Total	Appalachian No. 2	Ind., Ill., etc.	Minn., Wis., etc.	Okla., Kans., etc.	Total
INPUT 1974 p								
Crude petroleum:								
Domestic	61,851	24,231	86,082	13,467	610,850	21,190	323,251	968,758
Foreign	392,802	35,297	428,099	7,378	[1] 170,739	59,998	9,665	247,780
Total crude petroleum	454,653	59,528	514,181	20,845	781,589	81,188	332,916	1,216,538
Unfinished oils rerun (net)	+32,510	+653	+33,163	+743	−2,489	−69	+188	−1,627
Total crude and unfinished oils rerun	487,163	60,181	547,344	21,588	779,100	81,119	333,104	1,214,911
Natural gas liquids:								
Liquefied petroleum gases	248	128	376	713	16,230	2,406	11,810	31,159
Natural gasoline	263	--	263	--	5,238	3,548	12,762	21,548
Plant condensate	825	2,505	3,330	221	10,343	4,546	30	15,140
Total natural gas liquids	1,336	2,633	3,969	934	31,811	10,500	24,602	67,847
Other hydrocarbons and hydrogen	901	--	901	--	711	--	288	999
OUTPUT 1974 p								
Gasoline:								
Motor gasoline [2]	231,464	24,578	256,042	12,604	448,346	48,637	199,738	709,325
Aviation gasoline	264	--	264	--	1,829	--	459	2,288
Total gasoline [2]	231,728	24,578	256,306	12,604	450,175	48,637	200,197	711,613
Jet fuel:								
Naphtha-type	2,677	620	3,297	--	7,080	1,023	6,994	15,097
Kerosine-type	9,627	510	10,137	--	34,872	1,622	9,277	45,771
Total jet fuel	12,304	1,130	13,434	--	41,952	2,645	16,271	60,868
Ethane (including ethylene)	17	--	17	--	76	--	442	518
Liquefied refinery gases:								
For fuel use	10,290	1,010	11,300	448	15,176	1,514	5,995	23,133
For chemical use	5,712	--	5,712	--	3,108	--	790	3,898
Total liquefied refinery gases	16,002	1,010	17,012	448	18,284	1,514	6,785	27,031
Kerosine [2]	3,691	1,591	5,282	704	12,120	195	828	13,847
Distillate fuel oil [2]	120,524	15,454	135,978	4,731	167,594	22,460	85,995	280,780
Residual fuel oil	49,059	7,105	56,164	2,093	48,612	6,595	8,475	65,775
Petrochemical feedstocks:								
Still gas	792	62	854	--	2,664	--	89	2,753
Naphtha–400°	5,456	--	5,456	--	3,777	--	1,052	4,829
Other	482	742	1,224	--	1,954	--	188	2,142
Total petrochemical feedstocks	6,730	804	7,534	--	8,395	--	1,329	9,724
Special naphthas [2]	27	205	232	245	4,501	--	2,473	7,219
Lubricants:								
Bright stock	719	1,388	2,107	--	341	--	733	1,074
Neutral	2,502	2,833	5,335	--	3,051	--	3,031	6,082
Other grades	4,265	391	4,656	--	1,772	--	1,731	3,503
Total lubricants	7,486	4,612	12,098	--	5,164	--	5,495	10,659
Wax (280 pounds=1 barrel):								
Microcrystalline	78	142	220	--	--	--	296	296
Crystalline, fully refined	362	70	432	--	232	--	261	493
Crystalline, other	18	390	408	--	184	--	437	621
Total wax	458	602	1,060	--	416	--	994	1,410
Coke (1 short ton=5.0 barrels)	11,607	395	12,002	349	22,747	2,572	10,661	36,329
Asphalt (1 short ton=5.5 barrels)	32,372	1,491	33,863	1,366	33,696	5,948	14,770	55,780
Road oil	--	355	355	--	3,106	91	872	4,069
Still gas for fuel	17,390	1,867	19,257	484	30,115	2,432	11,417	44,448
Miscellaneous	2,483	2,270	4,753	70	1,853	9	816	2,748
Processing gain (−) or loss (+)	−22,478	−655	−23,133	−572	−37,184	−1,479	−9,826	−49,061

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p Preliminary.

[1] Includes some Athabasca hydrocarbons.

[2] Production at gas-processing plants shown as direct transfers and omitted from the input and output at refineries.

United States, by PAD district—Continued
barrels)

District III						District IV	District V	United States
Tex. inland	Tex. gulf	La. gulf	Ark., La. inland, etc.	N. Mex.	Total	Other Rocky Mt.	West coast	
149,839	813,067	533,895	56,392	22,417	1,575,610	137,175	400,971	3,168,596
3,594	221,624	61,422	269	--	286,909	16,268	281,074	[1]1,260,130
153,433	1,034,691	595,317	56,661	22,417	1,862,519	153,443	682,045	4,428,726
+893	−21,530	+18,107	+586	−1,162	−3,106	+1,049	+7,872	+37,351
154,326	1,013,161	613,424	57,247	21,255	1,859,413	154,492	689,917	4,466,077
5,819	12,396	18,191	965	592	37,963	3,607	7,112	80,217
15,729	80,872	17,766	1,272	994	116,633	1,945	7,214	147,603
512	9,178	1,325	3,428	--	14,443	9,171	2,512	44,596
22,060	102,446	37,282	5,665	1,586	169,039	14,723	16,838	272,416
144	554	4,995	548	6	6,247	315	4,595	13,057
92,926	510,439	314,749	22,701	9,820	950,635	81,998	322,488	2,320,488
1,996	4,536	2,220	--	--	8,752	464	4,127	15,895
94,922	514,975	316,969	22,701	9,820	959,387	82,462	326,615	2,336,383
6,632	8,733	9,811	1,891	2,092	29,159	4,302	19,320	71,175
7,617	53,453	52,692	3	72	113,837	4,841	59,303	233,889
14,249	62,186	62,503	1,894	2,164	142,996	9,143	78,623	305,064
96	3,813	1,375	--	--	5,284	--	511	6,330
3,229	16,390	11,198	1,142	389	32,348	1,780	13,000	81,561
290	17,543	3,860	260	4	21,957	88	3,778	35,433
3,519	33,933	15,058	1,402	393	54,305	1,868	16,778	116,994
1,088	20,054	10,950	778	774	33,644	874	2,999	56,646
30,479	244,144	137,236	12,664	4,870	429,393	45,426	82,187	973,764
8,573	78,607	33,386	8,599	2,837	132,002	12,396	124,154	390,491
300	9,516	777	--	--	10,593	121	54	14,375
3,308	40,030	2,116	329	--	45,783	--	6,500	62,568
3,468	22,680	26,577	295	--	53,020	--	1,435	57,821
7,076	72,226	29,470	624	--	109,396	121	7,989	134,764
1,275	16,971	152	1,898	1	20,297	108	5,506	33,862
--	2,122	560	--	--	2,682	45	1,296	7,204
--	9,755	6,391	874	--	17,020	291	2,635	31,363
8	19,671	1,326	1,288	--	22,293	86	1,589	32,127
8	31,548	8,277	2,162	--	41,995	422	5,520	70,694
87	162	27	329	--	605	14	1	1,136
--	526	886	--	--	1,412	68	627	3,032
--	931	95	--	--	1,026	29	677	2,761
87	1,619	1,008	329	--	3,043	111	1,305	6,929
3,454	22,403	13,036	743	202	39,838	3,854	31,723	123,746
7,205	9,673	14,579	8,974	907	41,338	9,887	23,369	164,237
24	--	--	21	--	45	536	2,157	7,162
5,399	37,322	30,478	1,480	656	75,335	5,642	31,042	175,724
1,518	5,531	7,519	130	3	14,701	72	2,241	24,515
−2,442	−38,844	−26,295	−939	+220	−68 300	−3,392	−31,369	−175,255

Table 22.—Percentage yields of refined petroleum products from crude oil in the United States[1]

Finished product	1970	1971	1972	1973	1974[p]
Gasoline	45.3	46.2	46.2	45.6	45.9
Jet fuel	7.5	7.4	7.2	6.8	6.8
Ethane (including ethylene)	.2	.2	.2	.2	.1
Liquefied gases	3.0	2.9	2.8	2.8	2.6
Kerosine	2.3	2.1	1.8	1.7	1.3
Distillate fuel oil	22.4	22.0	22.2	22.5	21.8
Residual fuel oil	6.4	6.6	6.8	7.7	8.7
Petrochemical feedstocks	2.5	2.7	2.9	2.9	3.0
Special naphthas	.8	.7	.7	.7	.8
Lubricants	1.6	1.6	1.5	1.5	1.6
Wax	.2	.2	.1	.2	.2
Coke	2.7	2.6	2.8	2.9	2.8
Asphalt	3.6	3.8	3.6	3.6	3.7
Road oil	.3	.2	.2	.2	.2
Still gas	4.1	3.8	3.9	3.9	3.9
Miscellaneous	.3	.4	.4	.4	.5
Shortage	−3.2	−3.4	−3.3	−3.6	−3.9
Total	100.0	100.0	100.0	100.0	100.0

[p] Preliminary.

[1] Other unfinished oils added to crude in computing yields.

Table 23.—Salient statistics of major refined petroleum products in the United States

(Thousand barrels)

Product	1971	1972	1973	1974[p]
Isopentane:				
Production	5,565	7,251	5,828	3,794
Stocks at plants	31	99	32	16
Used at refineries	5,541	7,183	5,895	3,810
Natural gasoline:				
Production	159,782	156,450	155,880	144,129
Stocks, end of year:				
At plants	3,647	3,285	5,043	5,202
At refineries	1,485	1,418	1,085	1,262
Total stocks	5,132	4,703	6,128	6,464
Used at refineries	160,681	156,879	154,455	143,793
Plant condensate:				
Production	25,754	22,022	19,833	17,733
Stocks end of year:				
At plants	594	768	739	507
At refineries	419	510	936	563
Total stocks	1,013	1,278	1,675	1,070
Imports	13,321	31,428	39,344	32,364
Used at refineries	39,020	53,190	56,911	44,596
Domestic demand	--	--	1,869	6,106
Finished gasoline:				
Production:				
At refineries	2,197,550	2,315,768	2,398,831	2,336,383
At gas-processing plants	5,023	4,182	3,029	1,084
Total gasoline production	2,202,573	2,319,950	2,401,860	2,337,467
Stocks, end of year:				
At refineries	223,544	217,025	213,334	221,817
At plants	227	124	83	64
Total stocks	223,771	217,149	213,417	221,881
Imports	21,658	24,787	48,759	74,402
Exports	1,649	656	1,664	1,013
Domestic demand	2,213,159	2,350,703	2,452,687	2,402,392
Motor gasoline:				
Production:				
At refineries	2,179,093	2,298,775	2,382,418	2,320,488
At gas-processing plants	5,023	4,182	3,029	1,084
Total motor gasoline production	2,184,116	2,302,957	2,385,447	2,321,572

See footnotes at end of table.

Table 23.—Salient statistics of the major refined petroleum products in the United States—Continued

(Thousand barrels)

Product	1971	1972	1973	1974p
Finished gasoline—Continued				
Motor gasoline—Continued				
Stocks, end of year:				
At refineries	219,125	212,770	209,395	218,346
At gas-processing plants	227	124	83	64
Total motor-gasoline stocks	219,352	212,894	209,478	218,410
Imports	21,658	24,787	48,759	74,402
Exports	410	424	1,466	865
Domestic demand	2,195,267	2,333,778	2,436,156	2,386,177
Aviation gasoline:				
Production	18,457	16,993	16,413	15,985
Stocks, end of year	4,419	4,255	3,939	3,471
Exports	1,239	232	198	148
Domestic demand	17,892	16,925	16,531	16,215
Jet fuel:				
Production	304,674	310,029	313,689	305,064
Stocks, end of year	27,737	25,493	28,544	29,435
Imports	65,172	71,174	77,557	59,396
Exports	1,536	957	1,568	969
Domestic demand	368,723	382,490	386,627	362,600
Naphtha-type:				
Production:				
At refineries	85,817	76,565	65,997	71,175
At gas-processing plants	9	--	--	--
Total production	85,826	76,565	65,997	71,175
Stocks, end of year:				
At refineries	6,988	6,147	5,599	5,529
At gas-processing plants	2	--	--	--
Total stocks	6,990	6,147	5,599	5,529
Imports	11,092	11,998	13,315	10,006
Exports	1,317	911	640	80
Domestic demand	94,732	88,495	79,220	81,171
Kerosine-type:				
Production	219,348	233,464	247,692	233,889
Stocks, end of year	20,747	19,346	22,945	23,906
Imports	54,620	59,176	64,242	49,390
Exports	219	46	928	889
Domestic demand	273,991	293,995	307,407	281,429
Ethane (including ethylene):				
Production:				
At gas-processing plants	80,524	100,691	108,220	117,791
At refineries	9,266	9,197	9,194	6,330
Total production	89,790	109,888	117,414	124,121
Stocks, end of year:				
At plants	3,365	7,052	5,023	4,562
At refineries	--	--	--	--
Total stocks	3,365	7,052	[1]5,023	[1]4,562
Domestic demand:				
Plant ethane	78,478	97,004	110,249	118,252
Refinery ethane and/or ethylene	9,266	9,197	9,194	6,330
Total domestic demand	87,744	106,201	119,443	124,582
Liquefied gases:				
Production:				
At gas-processing plants (LPG)	337,110	344,045	338,813	330,155
At refineries (LRG):				
For fuel use	88,648	84,514	89,570	81,561
For chemical use	32,304	36,668	38,062	35,433
Total production at refineries	120,952	121,182	127,632	116,994
Total production	458,062	465,227	466,445	447,149
Stocks, end of year:				
LPG stocks:				
At plants	80,294	67,807	83,086	97,956
At refineries	3,693	3,077	2,813	4,093
Total LPG stocks	83,987	70,884	85,899	102,049

See footnotes at end of table.

Table 23.—Salient statistics of the major refined petroleum products in the United States—Continued

(Thousand barrels)

Product	1971	1972	1973	1974p
Liquefied gases—Continued				
Stocks, end of year—Continued				
LRG stocks:				
For fuel use	6,992	7,487	7,403	5,757
For chemical use	369	294	316	174
Total LRG stocks	7,361	7,781	7,719	5,931
Total stocks	91,348	78,665	[1]93,618	[1]107,980
Imports	25,655	32,401	48,002	44,712
Exports	9,390	11,469	9,955	9,038
LPG used at refineries	79,695	85,193	80,221	80,217
Domestic demand:				
LPG for fuel and chemical use	249,767	292,887	281,624	269,462
LRG for fuel use	87,089	84,019	89,654	83,207
LRG for chemical use	32,152	36,743	38,040	35,575
Total domestic demand	369,008	413,649	409,318	388,244
Propane (including propylene):				
Production:				
At gas-processing plants	212,143	218,039	212,886	206,539
At refineries:				
For fuel use	71,934	69,038	73,531	62,298
For chemical use	21,512	25,024	25,329	25,155
Total production at refineries	93,446	94,062	98,860	87,453
Total production	305,589	312,101	311,746	293,992
Stocks, end of year:				
Plant propane stocks:				
At plants	56,779	48,219	59,704	64,713
At refineries	769	190	357	97
Total plant propane stocks	57,548	48,409	60,061	64,810
Refinery propane and/or propylene stocks:				
For fuel use	5,050	4,959	4,399	3,684
For chemical use	263	193	187	112
Total refinery propane and/or propylene stocks	5,313	5,152	4,586	3,796
Total stocks	62,861	53,561	64,647	68,606
Imports	11,606	15,851	25,791	21,464
Exports	4,685	6,502	5,500	4,971
Plant propane used at refineries	3,273	3,934	2,755	3,465
Domestic demand:				
Plant propane	197,138	232,593	213,770	214,818
Refinery propane and/or propylene:				
For fuel use	71,185	69,129	74,091	63,013
For chemical use	21,392	25,094	25,335	25,230
Total refinery propane and/or propylene domestic demand	92,580	94,223	99,426	88,243
Total domestic demand	289,718	326,816	313,196	303,061
Butane (including butylene):				
Production:				
At gas-processing plants	88,544	88,924	88,766	87,171
At refineries:				
For fuel use	13,765	12,940	13,036	13,598
For chemical use	5,886	5,673	6,666	6,442
Total production at refineries	19,651	18,613	19,702	20,040
Total production	108,195	107,587	108,468	107,211
Stocks, end of year:				
Plant butane stocks:				
At plants	13,571	10,389	15,289	20,992
At refineries	1,614	1,425	1,369	2,212
Total plant butane stocks	15,185	11,814	16,658	23,204

See footnotes at end of table.

Table 23.—Salient statistics of the major refined petroleum products in the United States—Continued

(Thousand barrels)

Product	1971	1972	1973	1974p
Liquefied gases—Continued				
Butane (including butylene)—Continued				
Stocks, end of year—Continued				
Refinery butane and/or butylene stocks:				
For fuel use	1,448	2,161	2,471	2,014
For chemical use	11	15	16	39
Total refinery butane and/or butylene stocks	1,459	2,176	2,487	2,053
Total stocks	16,644	13,990	19,145	25,257
Imports	14,049	16,550	22,211	23,248
Exports	4,725	4,967	4,455	4,067
Plant butane used at refineries	46,061	44,512	39,327	45,612
Domestic demand:				
Plant butane	51,433	59,366	62,351	54,194
Refinery butane and/or butylene:				
For fuel use	13,229	12,227	12,726	14,055
For chemical use	5,910	5,669	6,665	6,419
Total refinery butane and/or butylene	19,139	17,896	19,391	20,474
Total domestic demand	70,572	77,262	81,742	74,668
Butane-propane mixture:				
Production:				
At gas-processing plants	4,173	3,535	3,509	3,027
At refineries:				
For fuel use	2,949	2,536	3,003	5,665
For chemical use	3,029	3,892	3,491	655
Total production at refineries	5,978	6,428	6,494	6,320
Total production	10,151	9,963	10,003	9,347
Stocks, end of year:				
Plant butane-propane mixture:				
At plants	815	944	826	1,565
At refineries	38	31	128	26
Total plant butane-propane mixture stocks	853	975	954	1,591
Refinery butane-propane mixture:				
For fuel use	494	367	533	59
For chemical use	3	2	3	1
Total refinery butane-propane mixture stocks	497	369	536	60
Total stocks	1,350	1,344	1,490	1,651
Exports	--	--	--	--
Plant butane-propane mixture used at refineries	2,896	2,485	3,027	1,953
Domestic demand:				
Plant butane-propane mixture	1,192	928	503	437
Refinery butane-propane mixture:				
For fuel use	2,675	2,663	2,837	6,139
For chemical use	3,026	3,893	3,490	657
Total refinery butane-propane mixture	5,701	6,556	6,327	6,796
Total domestic demand	6,893	7,484	6,830	7,233
Isobutane:				
Production:				
At gas-processing plants	32,250	33,547	33,652	33,418
At refineries	1,877	2,079	2,576	3,181
Total production	34,127	35,626	36,228	36,599

See footnotes at end of table.

Table 23.—Salient statistics of the major refined petroleum products in the United States—Continued

(Thousand barrels)

Product	1971	1972	1973	1974p
Liquefied gases—Continued				
Isobutane—Continued				
Stocks, end of year:				
Plant isobutane:				
At plants	9,129	8,255	7,267	10,686
At refineries	1,272	1,431	959	1,758
Total plant isobutane stocks	10,401	9,686	8,226	12,444
Refinery isobutane	92	84	110	22
Total stocks	10,493	9,770	8,336	12,466
Plant isobutane used at refineries	27,465	34,262	35,112	29,187
Domestic demand:				
Refinery isobutane for chemical use	1,825	2,087	2,550	3,282
Kerosine (including range oil):				
Production:				
At refineries	86,256	79,027	79,422	56,646
At gas-processing plants	1,243	1,063	704	245
Total production	87,499	80,090	80,126	56,891
Stocks, end of year:				
At refineries	24,237	19,068	20,985	15,252
At plants	201	43	37	17
Total stocks	24,438	19,111	21,022	15,269
Imports	189	526	785	1,744
Exports	181	91	85	36
Domestic demand	90,917	85,852	78,915	64,352
Distillate fuel oil:				
Production:				
At refineries	910,727	962,405	1,029,343	973,764
At gas-processing plants	1,370	1,220	835	261
Total production	912,097	963,625	1,030,178	974,025
Crude used directly as distillate	1,548	944	760	774
Stocks, end of year:				
At refineries	190,534	[3]154,284	[3]196,421	[3]200,029
At plants	88	35	40	39
Total stocks	190,622	154,319	196,461	200,068
Imports	55,783	66,449	143,149	102,475
Exports	2,761	1,211	3,231	855
Domestic demand	971,316	1,066,110	1,128,714	1,072,812
Residual fuel oil:				
Production	274,684	292,519	354,597	390,491
Crude used directly as residual	4,565	3,322	6,126	4,751
Stocks, end of year	59,681	55,216	53,480	59,694
Imports	577,700	[3]637,401	[3]676,225	[3]573,752
Exports	13,217	12,060	8,507	4,969
Domestic demand	838,045	925,647	1,030,177	957,811
Petrochemical feedstocks (excluding LRG):[4]				
Production	110,948	124,026	132,564	134,764
Stocks, end of year	3,886	2,766	2,387	3,486
Imports	5,109	3,178	3,825	4,364
Exports	5,265	4,627	6,839	5,561
Domestic demand:				
Still gas	16,158	14,678	12,428	14,375
Naphtha—400°	56,821	58,075	56,822	61,879
Other	37,546	50,944	60,679	56,214
Total domestic demand	110,525	123,697	129,929	132,468
Special naphthas:				
Production:				
At refineries	28,255	32,096	32,873	33,362
At gas-processing plants	329	264	210	175
Total production	28,584	32,360	33,083	33,537
Stocks, end of year:				
At refineries	5,373	5,224	4,514	5,716
At plants	11	8	7	4
Total stocks	5,384	5,232	4,521	5,720
Imports	1,824	868	88	938
Exports	1,455	1,509	1,652	1,300
Domestic demand	29,762	31,866	32,230	31,976

See footnotes at end of table.

Table 23.—Salient statistics of the major refined petroleum products in the United States—Continued

(Thousand barrels)

Product	1971	1972	1973	1974p
Lubricants:				
Production	65,478	65,349	68,742	70,694
Stocks, end of year	15,049	13,271	12,186	16,060
Imports	10	669	2,091	1,786
Exports:				
Grease	235	227	251	277
Oil	15,590	14,756	12,496	11,659
Total exports	15,825	14,983	12,747	11,936
Domestic demand	49,821	52,813	59,171	56,670
Wax (1 barrel=280 pounds):				
Production	6,939	6,148	6,768	6,929
Stocks, end of year	1,117	1,061	990	1,195
Imports	93	385	1,067	956
Exports	1,660	1,180	965	879
Domestic demand	5.248	5,409	6,941	6,801
Coke (5 barrels=1 short ton):				
Production:				
Marketable coke	62,313	66,814	67,527	63,950
Catalyst coke	46,801	52,951	64.763	59,796
Total production	109,114	119,765	132,290	123,746
Stocks, end of year	7,445	7,816	9,974	5,420
Exports	27,069	31,118	34,976	41,244
Domestic demand	79,897	88,276	95,156	87,056
Asphalt (5.5 barrels=1 short ton):				
Production	157,039	155,294	167,884	164,287
Stocks, end of year	21,202	21,638	15,024	21,370
Imports	7,216	9,268	8,444	11,252
Exports	306	338	340	410
Domestic demand	158,526	163,788	182,602	168,783
Road oil:				
Production	8,755	7,943	7,326	7,162
Stocks, end of year	900	1,305	799	1,080
Domestic demand	8,487	7,538	7,832	6,881
Still gas for fuel:				
Production	156,967	170,998	176,758	175,724
Miscellaneous products:				
Production:				
At refineries	14,271	15,364	18,795	24,515
At gas-processing plants	1,156	1,028	1,066	731
Total production	15,427	16,392	19,861	25,246
Stocks, end of year:				
At refineries	1,593	1,632	1,378	1,815
At plants	11	22	16	10
Total stocks	1,604	1,654	1,394	1,825
Exports	1,028	1,058	1,187	1,207
Domestic demand	14,915	15,284	18,934	24,268
Unfinished oils (net):				
Input (+) output (—)	+43,608	+51,518	+45,768	+37,351
Stocks, end of year	100,574	94,761	99,154	106,031
Imports	45,193	45,705	50,161	44,228

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p Preliminary.

[1] Includes underground stocks at plants and refineries, in thousand barrels. At plants: Ethane, 1973, 3,921; 1974, 3,183; propane 1973, 52,090; 1974, 57,186; butane, 1973, 12,248; 1974, 18,522; butane-propane mixtures, 1973, 192; 1974, 894; and isobutane, 1973, 6,341; 1974, 9,809. At refineries (includes LRG): Propane, 1973, 4,074; 1974, 3,730; butane, 1973, 2,725; 1974, 3,324; butane-propane mixtures, 1973, 444; 1974, --; and isobutane, 1973, 765; 1974, 507.

[2] Includes No. 4 fuel oil, in thousand barrels: 1972, 3,723; 1973, 3,449; 1974, 4,116. Data for 1971 not available.

[3] Includes foreign crude oil to be burned as fuel, in thousand barrels: 1972, 10,419; 1973, 19,105; 1974, 7,508. Data for 1971 not available.

[4] Produced at petroleum refineries. Data for LRG petrochemical feedstocks are included with those for "Liquefied gases."

NOTE.—"Stocks at refineries" include stocks at refineries and bulk terminals operated by refining and refined products pipeline companies, including pipeline fill. "Stocks at plants" include stocks at plants and terminals operated by natural gas processing companies and natural gas liquids stocks at terminals of pipeline companies, including pipeline fill.

Table 24.—Production (refinery output) and consumption of gasoline (excluding naphtha) in the United States, by State

(Thousand barrels)

State	1972		1973		1974[p]	
	Production	Consumption[1]	Production	Consumption[1]	Production	Consumption[1]
Alabama	896	43,184	1,184	45,260	528	44,349
Alaska	(2)	2,920	(2)	3,232	(2)	3,883
Arizona	--	26,328	32	28,853	--	27,328
Arkansas	7,594	26,773	7,332	27,997	7,443	27,433
California	[2]263,533	241,164	[2]271,374	248,217	[2]266,529	235,428
Colorado	7,766	30,964	7,128	32,449	3,420	30,999
Connecticut	--	31,810	--	32,365	--	31,602
Delaware	(3)	6,970	(3)	7,347	(3)	7,059
District of Columbia	--	5,792	--	6,175	--	5,725
Florida	--	94,194	--	104,265	--	100,124
Georgia	--	64,012	--	67,589	(3)	65,229
Hawaii	(2)	6,844	(2)	6,589	(2)	6,615
Idaho	--	11,027	--	11,469	--	10,900
Illinois	176,948	115,526	221,182	120,557	216,355	119,637
Indiana	99,981	65,881	91,899	68,273	80,022	65,216
Iowa	--	39,853	--	43,357	--	39,215
Kansas	101,947	34,539	[4]104,207	34,125	[4]100,613	31,646
Kentucky	30,675	38,898	[5]29,493	40,623	[5]29,197	39,919
Louisiana	273,332	40,572	294,307	42,117	281,788	41,818
Maine	--	12,507	--	12,946	--	12,382
Maryland	--	42,523	--	44,104	--	42,606
Massachusetts	--	54,531	--	56,262	--	54,689
Michigan	27,047	109,170	20,509	113,999	19,543	108,694
Minnesota	33,772	50,236	36,768	51,320	34,959	48,431
Mississippi	49,946	28,686	49,111	29,530	49,911	28,461
Missouri	(4)	63,522	(4)	65,293	(4)	62,586
Montana	27,053	10,899	27,313	11,305	27,133	10,667
Nebraska	(4)	21,888	(4)	22,303	(4)	20,674
Nevada	--	8,909	--	9,471	(2)	9,110
New Hampshire	--	9,365	--	9,646	--	9,299
New Jersey	92,896	75,928	100,588	77,782	90,024	75,588
New Mexico	9,041	15,729	9,479	16,721	9,820	16,275
New York	16,950	144,194	17,584	150,080	14,749	142,806
North Carolina	(6)	65,892	(6)	68,429	(6)	67,150
North Dakota	[7]14,778	10,281	[7]15,088	10,404	[7]13,678	9,793
Ohio	115,896	118,624	114,993	124,801	117,662	119,193
Oklahoma	98,532	39,684	94,157	41,176	90,584	39,898
Oregon	--	28,541	--	29,695	--	28,278
Pennsylvania	[3]141,053	114,549	[3]144,102	116,064	[3]133,363	114,616
Rhode Island	--	9,843	--	9,984	--	8,851
South Carolina	--	33,624	--	35,200	--	34,682
South Dakota	--	11,203	--	11,402	--	10,868
Tennessee	(5)	50,714	(5)	54,675	(5)	51,948
Texas	609,515	168,928	617,666	179,763	609,897	169,030
Utah	21,454	16,405	22,335	16,827	21,331	14,677
Vermont	--	5,798	--	5,872	--	5,608
Virginia	[6]10,159	57,865	[6]10,708	60,667	[6]13,170	58,130
Washington	60,392	39,248	68,879	41,236	60,086	39,689
West Virginia	(6)	17,543	(6)	18,586	(6)	18,248
Wisconsin	(7)	51,810	(7)	52,790	(7)	51,084
Wyoming	24,612	6,879	26,518	7,244	25,578	7,011
Total	2,315,768	2,421,089	2,398,831	2,525,936	2,336,383	2,425,137

[p] Preliminary.

[1] American Petroleum Institute data for 1972 and 1973. U.S. Department of Transportation, Federal Highway Administration data for 1974.

[2] Alaska, Hawaii, and Nevada (1974) included with California.

[3] Delaware and Georgia (1974) included with Pennsylvania.

[4] Nebraska and Missouri included with Kansas.

[5] Tennessee included with Kentucky.

[6] North Carolina and West Virginia included with Virginia.

[7] Wisconsin included with North Dakota.

Table 25.—Salient statistics of motor gasoline in the United States, by month and refining district
(Thousand barrels)

	1973						1974 p					
	Production at refineries	Production at gas-processing plants	Imports	Exports	Total stocks, end of period[1]	Domestic demand	Production at refineries	Production at gas-processing plants	Imports	Exports	Total stocks, end of period[1]	Domestic demand
Month:												
January	196,571	327	1,841	32	221,954	189,647	182,900	178	5,047	126	217,542	179,935
February	171,940	288	2,667	142	216,484	180,223	167,140	75	5,163	18	219,105	170,797
March	190,648	330	2,193	22	207,732	201,901	185,443	84	6,960	225	220,347	191,020
April	191,315	301	1,902	130	204,877	196,243	189,329	88	7,790	41	223,805	193,708
May	208,147	307	3,146	151	202,201	214,125	196,186	83	7,754	10	218,711	209,107
June	209,792	199	5,214	28	208,466	208,912	199,892	82	6,324	11	217,421	207,577
July	216,572	211	4,110	70	211,572	217,717	210,573	86	6,562	21	218,889	215,732
August	213,277	212	5,091	8	205,189	224,955	211,259	83	7,849	172	219,004	218,904
September	198,580	218	3,816	27	210,359	197,417	193,590	63	6,056	15	227,070	191,628
October	205,249	218	6,020	251	214,610	206,985	196,427	92	5,303	17	220,797	208,078
November	191,259	205	6,492	459	207,418	204,689	188,751	81	5,224	13	218,444	196,396
December	189,068	213	6,267	146	209,478	193,342	198,998	89	4,370	196	218,410	203,295
Total	2,382,418	3,029	48,759	1,466	209,478	2,436,156	2,320,488	1,084	74,402	865	218,410	2,386,177
Refining district:												
East coast	245,194	--	42,603	3	53,666	816,314	231,464	--	64,176	3	53,657	784,892
Appalachian No. 1	27,315	--			5,225		24,578	--			4,984	
Appalachian No. 2	10,854	--			3,173		12,604	--			2,853	
Indiana, Illinois, Kentucky, etc	465,627	--	854	6	35,038	837,336	448,346	--	451	5	37,365	816,839
Minnesota, Wisconsin, etc	51,806	--			7,893		48,637	--			7,958	
Oklahoma, Kansas, etc	197,844	--			19,298		199,738	--			19,338	
Texas inland	97,473	681	3,510	1,290	8,612	852,486	92,926	655	6,851	556	9,272	362,069
Texas gulf coast	518,108	209			20,279		510,439	212			25,117	
Louisiana gulf coast	328,709	1,513			12,847		314,749	94			14,855	
Arkansas, Louisiana inland, etc	20,628	626			11,797		22,701	123			10,459	
New Mexico	9,479	--			804		9,820	--			851	
Rocky Mountain	82,846	--	568	--	7,625	74,846	81,998	--	322	--	7,482	76,430
West coast	331,535	--	1,224	167	23,221	355,174	322,488	--	2,602	301	24,219	345,947
Total	2,382,418	3,029	48,759	1,466	209,478	2,436,156	2,320,488	1,084	74,402	865	218,410	2,386,177

p Preliminary.

[1] Includes stocks of gasoline at refineries, bulk terminals, pipelines and gas-processing plants.

Table 26.—Salient statistics of aviation gasoline in the United States, by month and refining district

(Thousand barrels)

	1973				1974 p			
	Production	Exports	Stocks, end of period	Domestic demand	Production	Exports	Stocks, end of period	Domestic demand
Month:								
January	1,001	7	4,024	1,225	1,120	9	3,785	1,265
February	775	12	3,551	1,236	973	3	3,885	870
March	1,180	67	3,349	1,315	1,010	6	3,234	1,655
April	1,241	4	3,309	1,277	1,075	9	3,024	1,276
May	1,378	6	3,109	1,572	1,477	8	3,168	1,325
June	1,335	6	3,089	1,349	1,444	7	3,094	1,511
July	1,562	12	3,437	1,202	1,567	15	3,273	1,373
August	1,942	49	3,417	1,913	1,684	65	3,057	1,835
September	1,444	8	3,529	1,324	1,934	4	3,646	1,341
October	1,654	10	3,598	1,575	1,301	5	3,347	1,595
November	1,753	8	3,982	1,361	1,290	8	3,457	1,172
December	1,148	9	3,939	1,182	1,020	9	3,471	997
Total	16,413	198	3,939	16,531	15,895	148	3,471	16,215
Refining district:								
East coast	428	28	545	3,792	264	9	529	3,379
Appalachian No. 1	--		52		--		84	
Appalachian No. 2	--	12	1	4,325	--	2	2	4,144
Illinois, Indiana, Kentucky, etc	1,595		615		1,829		623	
Minnesota, Wisconsin, etc	--		99		--		91	
Oklahoma, Kansas, etc	520		204		459		191	
Texas inland	2,272	42	291	3,960	1,996	73	186	3,973
Texas gulf coast	4,813		713		4,536		578	
Louisiana gulf coast	2,597		646		2,220		427	
Arkansas, Louisiana inland, etc	--		2		--		30	
New Mexico	--		16		--		8	
Rocky Mountain	443	--	54	687	464	--	49	630
West coast	3,750	116	701	3,767	4,127	64	673	4,089
Total	16,413	198	3,939	16,531	15,895	148	3,471	16,215

p Preliminary.

Table 27.—Shipments of aviation fuels to PAD districts

(Thousand barrels)

Product and use	District I	District II	District III	District IV	District V	United States
1973						
Aviation gasoline:						
For commercial use:						
Airlines	575	487	308	16	136	1,522
Factory	45	70	33	6	70	224
General aviation	2,362	2,603	1,803	639	2,355	9,762
Total	2,982	3,160	2,144	661	2,561	11,508
For military use	1,264	975	1,131	63	1,502	4,935
Jet fuel:						
For commercial use:						
Kerosine-type:						
Airlines	r 105,527	57,068	20,317	7,626	72,874	r 263,412
Factory	858	1,276	292	--	562	2,988
General aviation	3,411	2,532	1,277	423	899	8,542
Total	r 109,796	60,876	21,886	8,049	74,335	r 274,942
Naphtha-type:						
Airlines	2,503	4	661	--	4,254	7,422
Factory	224	142	15	--	100	481
General aviation	67	184	94	--	59	404
Total	2,794	330	770	--	4,413	8,307
Total for commercial use	r 112,590	61,206	22,656	8,049	78,748	r 283,249
For military use:						
JP-4[1]	13,137	12,939	13,184	3,162	18,168	60,590
JP-5[2]	10,783	117	653	--	13,411	24,964
Other	192	11	3	--	271	477
Total	24,112	13,067	13,840	3,162	31,850	86,031
For nonaviation use	4,630	1,266	150	--	303	6,349
1974						
Aviation gasoline:						
For commercial use:						
Airlines	552	461	116	13	221	1,363
Factory	31	60	31	2	45	169
General aviation	2,491	2,498	1,737	604	2,270	9,600
Total	3,074	3,019	1,884	619	2,536	11,132
For military use	852	1,000	1,415	144	1,584	4,995
Jet fuel:						
For commercial use:						
Kerosine-type:						
Airlines	94,679	49,389	22,276	6,896	65,904	239,144
Factory	1,157	1,127	285	5	430	3,004
General aviation	3,361	3,112	2,486	497	1,691	11,147
Total	99,197	53,628	25,047	7,398	68,025	253,295
Naphtha-type:						
Airlines	3,951	103	1,388	92	3,349	8,883
Factory	12	260	20	--	10	302
General aviation	101	103	87	7	60	358
Total	4,064	466	1,495	99	3,419	9,543
Total for commercial use	103,261	54,094	26,542	7,497	71,444	262,838
For military use:						
JP-4[3]	12,243	15,327	13,361	3,032	19,494	63,457
JP-5[4]	9,260	338	973	--	9,194	19,765
Other	131	8	187	--	1,940	2,266
Total	21,634	15,673	14,521	3,032	30,628	85,488
For nonaviation use	3,878	839	213	9	231	5,170

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r Revised.

[1] Excludes direct imports by the military of naphtha-type jet fuel into PAD district I, 8,993,000 barrels, and PAD district V, 1,946,000 barrels.

[2] Excludes direct imports by the military of kerosine-type jet fuel into PAD district I, 376,000 barrels, and PAD district V, 140,000 barrels.

[3] Excludes direct imports by the military of naphtha-type jet fuel into PAD district I, 6,318,000 barrels, and PAD district V, 1,664,000 barrels.

[4] Excludes direct imports by the military of kerosine-type jet fuel into PAD district I, 660,000 barrels, and PAD district V, 73,000 barrels.

Table 28.—Salient statistics of jet fuel in the United States, by month and refining district

(Thousand barrels)

	Production			Imports			Exports			Total stocks, end of period			Domestic demand		
	Naphtha-type	Kerosine-type	Total	Naphtha-type	Kerosine-type	Total	Naphtha-type	Kerosine-type	Total	Naphtha-type	Kerosine-type	Total	Naphtha-type	Kerosine-type	Total
1973															
Month:															
January	5,281	21,506	26,787	777	6,380	7,157	180	34	214	5,953	18,861	24,814	6,072	28,337	34,409
February	4,589	20,567	25,156	440	5,759	6,199	184	21	205	5,486	19,951	25,437	5,312	25,215	30,527
March	6,057	22,369	28,426	394	4,330	4,724	169	29	198	5,899	21,686	27,585	5,869	24,935	30,804
April	5,955	20,658	26,613	846	3,507	4,353	54	172	226	5,209	22,672	27,881	7,437	23,007	30,444
May	6,005	20,031	26,036	681	5,846	6,527	22	112	134	5,055	20,770	25,825	6,818	27,667	34,485
June	5,344	19,731	25,075	926	3,981	4,907	11	128	139	4,603	20,844	25,447	6,711	23,510	30,221
July	4,833	20,739	25,572	981	6,196	7,177	3	105	108	4,280	21,381	25,661	6,134	26,293	32,427
August	5,371	20,802	26,173	1,858	3,715	5,573	--	32	32	4,268	20,583	24,851	7,241	25,283	32,524
September	5,578	19,841	25,419	1,219	5,829	7,048	-	58	58	4,652	20,497	25,149	6,413	25,698	32,111
October	5,278	21,851	27,129	2,218	5,418	7,636	1	100	101	4,242	21,335	25,577	7,905	26,331	34,236
November	4,905	20,668	25,573	1,695	6,546	8,241	11	92	103	4,939	23,600	28,539	5,892	24,857	30,749
December	6,801	18,929	25,730	1,280	6,735	8,015	5	45	50	5,599	22,945	28,544	7,416	26,274	33,690
Total	65,997	247,692	313,689	13,315	64,242	77,557	640	928	1,568	5,599	22,945	28,544	79,220	307,407	386,627
Refining district:															
East coast	1,907	11,223	13,130	10,000	34,829	44,829	2	2	4	188	5,027	5,215	22,724	129,711	152,435
Appalachian No. 1	89	695	1,514							105	208	313			
Appalachian No. 2	--	--	--	--	2,697	2,697	--	--	--	9	206	215	13,008	61,879	74,887
Indiana, Illinois, Kentucky, etc	5,738	38,671	44,409							362	3,840	4,202			
Minnesota, Wisconsin, etc	981	1,490	2,471							153	705	858			
Oklahoma, Kansas, etc	5,218	10,627	15,845							690	1,275	1,965			
Texas inland	5,579	8,004	13,583	--	6,073	6,073	1	--	1	363	1,069	1,432	16,693	19,675	36,368
Texas gulf coast	10,775	56,473	67,248							932	3,245	4,177			
Louisiana gullf coast	7,677	49,630	57,307							569	1,348	1,917			
Arkansas, Louisiana inland, etc	1,610	1	1,611							172	438	610			
New Mexico	2,052	65	2,117							218	78	296			
Rocky Mountain	3,493	4,611	8,104	--	--	--	--	--	--	230	385	615	2,878	8,320	11,198
West coast	20,148	66,202	86,350	3,315	20,643	23,958	637	926	1,563	1,608	5,121	6,729	23,917	87,822	111,739
Total	65,997	247,692	313,689	13,315	64,242	77,557	640	928	1,568	5,599	22,945	28,544	79,220	307,407	386,627

1974[p]															
Month:															
January	5,453	19,341	24,794	145	4,065	4,210	4	62	66	5,828	23,904	29,732	5,365	22,385	27,750
February	4,859	17,066	21,925	26	2,073	2,099	7	53	60	6,069	23,548	29,617	4,637	19,442	24,079
March	6,661	19,122	25,783	292	4,009	4,301	5	74	79	6,711	23,285	29,996	6,306	23,320	29,626
April	6,128	19,919	26,047	529	3,436	3,965	4	63	67	6,837	24,888	31,725	6,527	21,689	28,216
May	6,850	20,059	26,909	1,417	4,946	6,363	4	22	26	6,701	25,623	32,324	8,399	24,248	32,647
June	6,427	17,869	24,296	816	3,413	4,229	5	93	98	6,677	25,523	32,200	7,262	21,289	28,551
July	5,183	19,678	24,861	1,206	5,435	6,641	3	157	160	6,436	25,235	31,671	6,627	25,244	31,871
August	5,162	19,790	24,952	1,553	4,839	6,392	5	60	65	5,742	25,247	30,989	7,404	24,557	31,961
September	6,482	19,533	26,015	1,449	5,053	6,502	3	37	40	5,779	24,407	30,186	7,891	25,389	33,280
October	6,118	20,783	26,901	802	4,180	4,982	4	155	159	5,606	24,958	30,564	7,089	24,257	31,346
November	6,497	19,388	25,885	987	3,206	4,193	5	67	72	5,883	23,733	29,616	7,202	23,752	30,954
December	5,355	21,341	26,696	784	4,735	5.519	31	46	77	5,529	23,906	29,435	6,462	25,857	32,319
Total	71,175	233,889	305,064	10,006	49,390	59,396	80	889	969	5,529	23,906	29,435	81,171	281,429	362,600
Refining district:															
East coast	2,677	9,627	12,304	6,769	27,789	34,558	1	2	3	182	4,963	5,145	20,739	114,345	135,084
Appalachian No. 1	620	510	1,130							39	313	352			
Appalachian No. 2	--	--	--	--	1,575	1,575	--	--	--	49	179	228	15,256	55,010	70,266
Indiana, Illinois, Kentucky, etc	7,080	34,872	41,952							574	3,409	3,983			
Minnesota, Wisconsin, etc	1,023	1,622	2,645							164	787	951			
Oklahoma, Kansas, etc	6,994	9,277	16,271							742	1,105	1,847			
Texas inland	6,632	7,617	14,249	861	2,987	3,848	--	--	--	353	1,088	1,441	18,085	25,339	43,424
Texas gulf coast	8,733	53,453	62,186							479	3,306	3,785			
Louisiana gulf coast	9,811	52,692	62,503							841	2,821	3,662			
Arkansas, Louisiana inland, etc	1,891	3	1,894							220	245	465			
New Mexico	2,092	72	2,164							226	76	302			
Rocky Mountain	4,302	4,841	9.143	--	--	--	--	--	--	298	449	747	2,983	7,840	10,823
West coast	19,320	59,303	78,623	2,376	17,039	19,415	79	887	966	1.362	5,165	6.527	24,108	78,895	103,003
Total	71,175	233,889	305,064	10,006	49,390	59,396	80	889	969	5,529	23,906	29,435	81,171	281,429	362,600

[p] Preliminary.

Table 29.—Salient statistics of ethane (including ethylene) in the United States, by month and refining district

(Thousand barrels)

	1973					1974[p]				
	Production			Total stocks, end of period	Domestic demand	Production			Total stocks, end of period	Domestic demand
	At gas-processing plants	At refineries	Total			At gas-processing plants	At refineries	Total		
Month:										
January	8,999	722	9,721	7,139	9,634	9,456	673	10,129	4,747	10,405
February	8,417	659	9,076	7,126	9,089	9,003	684	9,687	4,451	9,983
March	9,725	736	10,461	7,173	10,414	10,784	715	11,499	4,533	11,417
April	8,805	687	9,492	6,869	9,796	9,725	459	10,184	4,644	10,073
May	9,097	892	9,989	6,976	9,882	9,945	477	10,422	5,185	9,881
June	8,602	849	9,451	6,733	9,694	9,441	447	9,888	5,424	9,649
July	8,792	842	9,634	6,734	9,633	9,554	486	10,040	5,423	10,041
August	8,966	898	9,864	6,374	10,224	9,659	492	10,151	5,319	10,255
September	8,670	717	9,387	6,198	9,563	9,168	456	9,624	5,088	9,855
October	9,316	713	10,029	6,139	10,088	10,344	533	10,877	4,945	11,020
November	9,272	759	10,031	5,381	10,789	10,112	457	10,569	4,560	10,954
December	9,559	720	10,279	5,023	10,637	10,600	451	11,051	4,562	11,049
Total	108,220	9,194	117,414	5,023	119,443	117,791	6,330	124,121	4,562	124,582
Refining district:										
East coast	--	58	58	--	1,779	--	17	17	--	1,686
Appalachian No. 1	1,721	--	1,721			1,669	--	1,669		
Appalachian No. 2	--	--	--	1,225	13,399	--	--	--	1,550	14,899
Indiana, Illinois, Kentucky, etc	7,451	--	7,451			7,252	76	7,328		
Minnesota, Wisconsin, etc	--	--	--			--	--	--		
Oklahoma, Kansas, etc	5,667	520	6,187			7,454	442	7,896		
Texas inland	40,158	108	40,266	3,795	103,713	42,680	96	42,776	3,009	107,244
Texas gulf coast	16,475	5,040	21,515			16,491	3,813	20,304		
Louisiana gulf coast	31,191	2,960	34,151			36,348	1,375	37,723		
Arkansas, Louisiana inland, etc	1,229	--	1,229			1,033	--	1,033		
New Mexico	4,283	--	4,283			4,622	--	4,622		
Rocky Mountain	45	--	45	3	44	242	--	242	3	242
West coast	--	508	508	--	508	--	511	511	--	511
Total	108,220	9,194	117,414	5,023	119,443	117,791	6,330	124,121	4,562	124,582

[p] Preliminary.

Table 30.—Salient statistics of liquefied gases (excluding ethane) in the United States, by month and refining district

(Thousand barrels unless otherwise indicated)

	1973								1974 p							
	Refinery production	Yield (percent)	Production at gas-processing plants	Imports	Exports	LPG used at refineries	Total stocks, end of period	Domestic demand	Refinery production	Yield (percent)	Production at gas-processing plants	Imports	Exports	LPG used at refineries	Total stocks, end of period	Domestic demand
Month:																
January	10,466	2.8	28,377	6,315	892	8,666	62,083	52,182	9,453	2.6	28,149	6,381	840	7,073	85,332	44,356
February	9,400	2.7	26,980	5,317	1,139	6,982	52,756	42,903	8,753	2.8	26,018	4,790	604	6,015	84,049	34,225
March	10,988	2.9	28,925	4,558	1,109	6,377	56,584	33,157	9,841	2.9	29,201	3,716	725	5,900	88,372	31,810
April	10,503	2.9	28,924	2,697	797	5,238	63,572	29,101	10,131	2.8	27,798	3,389	683	5,303	94,803	28,901
May	12,147	3.2	29,317	3,511	777	5,285	73,062	29,423	10,053	2.7	28,157	3,633	710	5,765	104,168	26,003
June	10,795	2.8	28,163	2,273	705	5,494	83,315	24,779	10,602	2.8	26,723	3,594	701	5,779	111,204	27,403
July	11,869	2.9	27,720	2,683	788	5,934	94,296	24,569	10,808	2.7	27,043	2,637	844	5,770	118,982	26,096
August	11,193	2.8	27,649	4,014	820	6,617	100,476	29,239	10,701	2.7	27,301	2,567	753	6,431	125,392	26,975
September	10,373	2.7	27,361	2,961	766	6,254	105,067	29,084	9,986	2.7	26,331	2,296	816	6,646	126,169	30,374
October	10,968	2.7	28,661	4,610	758	7,483	105,116	35,949	9,683	2.5	28,083	3,381	797	7,814	123,987	34,718
November	9,176	2.5	27,985	5,120	683	7,853	98,834	40,027	8,562	2.3	27,383	3,259	744	8,211	117,831	36,405
December	9,754	2.5	28,751	3,943	721	8,038	93,618	38,905	8,421	2.2	27,968	5,069	821	9,510	107,980	40,978
Total or average	127,632	2.8	338,813	48,002	9,955	80,221	93,618	409,318	116,994	2.6	330,155	44,712	9,038	80,217	107,980	388,244
Refining district:																
East coast	19,346	3.7	5,756	8,571	37	148	5,590	65,340	16,002	3.3	5,945	5,958	31	248	4,111	57,725
Appalachian No. 1	1,412	2.2				127			1,010	1.7				128		
Appalachian No. 2	367	1.8							448	2.1				713		
Indiana, Illinois, Kentucky, etc	19,209	2.3	54,787	18,417	324	11,948	32,976	125,661	18,284	2.3	55,476	19,304	78	16,230	36,688	128,286
Minnesota, Wisconsin, etc	1,522	1.7				2,973			1,514	1.9				2,406		
Oklahoma, Kansas, etc	8,473	2.5	261,535	9,271	7,867	11,784	52,905	186,971	6,785	2.0	252,199	9,307	7,327	11,810	64,559	172,507
Texas inland	3,399	2.2				7,052			3,519	2.3				5,819		
Texas gulf coast	32,800	3.3				13,954			33,933	3.3				12,396		
Louisiana gulf coast	21,134	3.4				19,864			15,058	2.4				18,191		
Arkansas, Louisiana inland, etc	1,024	2.0				1,093			1,402	2.4				965		
New Mexico	369	2.2				615			393	1.9				592		
Rocky Mountain	2,236	1.5	11,406	5,496	1	3,443	664	10,389	1,868	1.2	11,440	5,535	--	3,607	830	9,431
West coast	16,341	2.3	5,329	6,247	1,726	7,220	1,483	20,957	16,778	2.4	5,095	4,608	1,602	7,112	1,792	20,295
Total or average	127,632	2.8	338,813	48,002	9,955	80,221	93,618	409,318	116,994	2.6	330,155	44,712	9,038	80,217	107,980	388,244

p Preliminary.

Table 31.—Salient statistics of kerosine in the United States, by month and refining district

(Thousand barrels unless otherwise indicated)

	1973							1974[p]						
	Production at refineries	Yield (percent)	Production at gas-processing plants	Imports	Exports	Total stocks, end of period	Domestic demand	Production at refineries	Yield (percent)	Production at gas-processing plants	Imports	Exports	Total stocks, end of period	Domestic demand
Month:														
January	9,446	2.4	69	6	9	16,038	12,585	5,900	1.6	42	182	3	17,486	9,657
February	9,290	2.7	72	4	8	14,612	10,784	5,595	1.8	29	365	--	15,609	7,866
March	7,931	2.1	78	12	7	16,404	6,222	4,651	1.3	30	232	3	15,001	5,518
April	6,507	1.8	71	--	--	18,088	4,894	3,591	1.0	27	158	5	14,873	3,899
May	5,093	1.3	71	6	8	19,148	4,102	3,897	1.0	26	--	7	16,579	2,210
June	4,486	1.1	47	8	--	20,160	3,529	4,038	1.0	12	130	2	17,315	3,442
July	4,874	1.2	49	--	4	20,477	4,602	3,695	.9	12	41	4	17,195	3,864
August	5,392	1.3	51	224	8	21,590	4,546	4,088	1.0	12	153	2	17,086	4,360
September	5,849	1.6	51	156	7	22,105	5,534	4,099	1.1	12	21	3	17,079	4,136
October	6,963	1.7	51	--	7	23,549	5,563	5,788	1.5	15	85	4	16,999	5,964
November	6,553	1.7	48	245	24	21,208	9,168	5,342	1.4	14	218	--	16,707	5,866
December	7,038	1.8	46	124	3	21,022	7,386	5,962	1.5	14	159	3	15,269	7,570
Total or average	79,422	1.7	704	785	85	21,022	78,915	56,646	1.3	245	1,744	36	15,269	64,352
Refining district:														
East coast	5,079	1.0	--	785	4	7.877	32,992	3,691	.8	--	1,453	8	6,439	27,122
Appalachian No. 1	1,930	3.0	--			624		1,591	2.6	--			468	
Appalachian No. 2	814	4.1	--	--	--	371	23,439	704	3.3	--	--	2	317	18,815
Indiana, Illinois, Kentucky, etc	15,743	1.9	--			4,201		12,120	1.6	--			3,004	
Minnesota, Wisconsin, etc	1,242	1.4	--			644		195	.2	--			248	
Oklahoma, Kansas, etc	2,088	.7	--			998		828	.3	--			731	
Texas inland	1,130	.7	356	--	65	285	19,223	1,088	.7	154	291	14	239	14,182
Texas gulf coast	26,883	2.8	41			1,912		20,054	2.0	29			1,982	
Louisiana gulf coast	20,074	3.2	138			2,558		10,950	1.8	11			880	
Arkansas, Louisiana inland, etc	785	1.6	123			637		778	1.4	--			409	
New Mexico	131	.8	46			20		774	3.6	51			52	
Rocky Mountain	2,204	1.4	--	--	--	477	1,985	874	.6	--	--	--	169	1,165
West coast	1,319	.2	--	--	16	418	1,276	2,999	.4	--	--	12	336	3,068
Total or average	79,422	1.7	704	785	85	21,022	78,915	56,646	1.3	245	1,744	36	15,269	64,352

[p] Preliminary.

Table 32.—Sales of distillate fuel oil[1] in the United States in 1970–74, by use

(Million barrels)

Use	1970	1971	1972	1973	1974
Heating[2]	521.1	522.5	543.3	586.9	493.2
Industrial (excluding oil-company use)	43.7	50.7	60.4	67.3	64.0
Oil-company use	11.5	14.1	13.4	14.9	13.8
Electric utility companies	24.8	35.3	68.3	[3] 77.9	[4] 84.7
Railroads	88.4	86.2	97.0	102.8	103.0
Vessels	19.5	21.0	22.2	26.8	24.8
Military	12.4	17.4	20.2	19.6	17.8
On-highway diesel	148.8	167.0	189.1	221.4	221.0
Off-highway diesel	46.1	46.9	50.2	55.5	48.7
All other	10.9	10.2	10.8	11.9	10.1
Total	927.2	971.3	1,074.9	1,185.0	1,081.1

[1] Includes diesel fuel.

[2] Includes range oil.

[3] Includes approximately 23 milllion barrels of distillate No. 2, approximately 2.1 million barrels of distillate No. 4 fuel oil used at steam-electric plants, and 6.3 million barrels of kerosine-type jet fuel used by electric utility companies.

[4] Includes 23.6 million barrels of distillate No. 2 and 3.0 million barrels of distillate No. 4 fuel oil used at steam-electric plants. Also included are 5.2 million barrels of kerosine-type jet fuel used by electric utility companies.

Table 33.—Salient statistics of distillate fuel oil in the United States, by month and refining district

(Thousand barrels unless otherwise indicated)

	1973								1974 p							
	Production at refineries	Yield (percent)	Production at gas-processing plants	Crude used directly as distillate [1]	Imports	Exports	Total stocks, end of period	Domestic demand	Production at refineries	Yield (percent)	Production at gas-processing plants	Crude used directly as distillate [1]	Imports	Exports	Total stocks, end of period	Domestic demand
Month:																
January	93,862	24.2	97	44	11,289	332	130,993	128,286	89,287	24.7	54	61	13,905	125	181,217	118,426
February	82,242	23.9	73	42	20,474	67	113,310	120,447	67,166	21.2	19	56	8,196	108	149,162	107,384
March	82,679	22.2	85	76	18,672	72	111,299	108,451	69,014	20.0	23	52	8,288	204	128,852	97,483
April	75,806	20.7	76	69	7,207	197	114,723	79,037	75,655	21.1	20	55	6,490	41	125,587	85,444
May	78,860	20.5	85	67	8,301	54	119,131	82,851	83,838	21.9	17	72	8,409	27	141,843	76,053
June	84,759	21.6	64	68	6,660	253	137,869	72,560	83,485	21.8	19	89	6,853	34	160,680	71,575
July	85,299	21.3	62	81	9,870	105	160,901	72,175	86,547	21.5	18	62	6,648	84	182,495	71,376
August	86,840	21.7	56	64	8,915	264	177,304	79,208	83,852	21.0	16	70	3,451	17	198,710	71,157
September	84,379	22.3	60	69	9,399	761	190,209	80,241	76,546	20.8	20	63	4,308	41	208,308	71,298
October	90,230	22.6	62	76	13,978	721	203,000	90,884	83,696	21.9	17	74	6,618	15	209,945	88,753
November	87,672	23.4	58	46	14,769	97	200,218	105,230	84,019	22.5	19	55	13,288	55	212,913	94,358
December	97,215	25.2	57	58	13,615	308	[2]196,461	114,394	90,659	23.0	19	65	16,021	104	200,068	119,505
Total or average	1,029.343	22.5	835	760	143.149	3,231	[2]196,461	1,128,714	973,764	21.8	261	774	102.475	855	200,068	1,072,812
Refining district:																
East coast	130,868	25.0	--	--	125,210	206	75,359	525,979	120,524	24.7	--	--	93,713	33	72,892	488,836
Appalachian No. 1	16,135	25.2	--				4,119		15,454	25.7	--				3,847	
Appalachian No. 2	4,674	23.3	--	283	1,353	137	2,751	327,155	4,731	21.9	--	283	626	5	2,333	320,956
Indiana, Illinois, Kentucky, etc.	182,761	22.0	--				32,281		167,594	21.5	--				30,367	
Minnesota, Wisconsin, etc	24,612	27.9	--				8,675		22,460	27.7	--				9,432	
Oklahoma, Kansas, etc	85,749	25.6	--				17,477		85,995	25.8	--				19,424	
Texas inland	31,189	20.1	98	191	12,406	2,007	3,401	127,024	30,479	19.7	99	191	5,569	286	3,183	129,206
Texas gulf coast	244,178	24.5	76				19,299		244,144	24.1	47				23,590	
Louisiana gulf coast	149,311	24.0	518				9,994		137,236	22.4	93				8,874	
Arkansas, Louisiana inland, etc	11,700	23.4	143				4,854		12,664	22.1	22				7,482	
New Mexico	3,601	21.2	.				276		4,870	22.9	--				347	
Rocky Mountain	41,966	27.7	--	69	104	1	4,150	34,888	45,426	29.4	--	69	46		3,982	38,760
West coast	102,599	14.0	--	217	4,076	880	13,825	113,668	82,187	11.9	--	231	2,521	531	14,315	95,054
Total or average	1,029,343	22.5	835	760	143,149	3,231	[2]196,461	1,128,714	973,764	21.8	261	774	102,475	855	200,068	1,072,812

p Preliminary.

[1] Figures represent crude oil used as fuel on pipelines, which is considered part of the demand for distillate.

[2] Includes No. 4 fuel oil, in thousand barrels: PAD district I, 1973—3,068, 1974—3,622; PAD district II, 1973—129, 1974—33; PAD district III, 1973—170, 1974—438; PAD district IV, 1973—15, 1974—16; PAD district V, 1973—67, 1974—7.

Table 34.—Salient statistics of residual fuel oil in the United States, by month and refining district

(Thousand barrels unless otherwise indicated)

	1973							1974 p						
	Production	Yield (percent)	Crude used directly as residual 1	Imports	Exports	Stocks, end of period	Domestic demand	Production	Yield (percent)	Crude used directly as residual 1	Imports	Exports	Stocks, end of period	Domestic demand
Month:														
January	34,472	8.9	330	62,591	970	49,154	102,485	33,222	9.2	513	53,704	292	46,548	94,079
February	29,053	8.5	312	60,111	888	43,058	94,684	28,808	9.1	407	53,831	317	45,004	84,273
March	29,592	8.0	329	68,062	741	44,711	95,589	28,259	8.2	356	51,892	286	47,222	78,003
April	26,315	7.2	326	51,160	1,172	47,044	74,296	29,539	8.2	373	47,623	469	51,339	72,949
May	29,392	7.6	320	51,707	1,091	49,207	78,165	30,835	8.1	364	41,957	357	54,356	69,782
June	27,448	7.0	729	52,824	183	51,811	78,214	30,773	8.0	355	46,478	435	57,891	73,636
July	27,352	6.8	492	49,518	1,046	53,363	74,764	32,727	8.1	358	44,408	215	59,787	75,382
August	26,368	6.6	813	59,313	852	53,586	85,419	33,072	8.3	351	47,416	932	60,988	78,706
September	26,338	7.0	568	55,471	593	55,091	80,279	30,963	8.4	357	41,999	451	60,251	73,605
October	30,517	7.7	722	49,509	585	54,964	80,290	34,060	8.9	398	45,394	508	58,679	80,916
November	31,840	8.5	690	59,365	145	51,985	94,729	36,861	9.9	545	49,087	241	60,363	84,568
December	35,910	9.3	495	56,594	241	53,480	91,263	41,372	10.5	374	49,963	466	59,694	91,912
Total or average	2 354,597	7.7	6,126	3 676,225	8,507	53,480	1,030,177	2 390,491	8.7	4,751	3 573,752	4,969	59,694	957,811
Refining district:														
East coast	45,238	8.7	--	4 639,611	87	24,782	708,418	49,059	10.1	--	5 532,350	102	26,961	622,214
Appalachian No. 1	7,020	11.0				686		7,105	11.8				678	
Appalachian No. 2	1,758	8.8	578	4 6,068	179	316	87,088	2,098	9.7	578	5 7,930	64	405	87,689
Indiana, Illinois, Kentucky, etc	53,612	6.5				5,668		48,612	6.2				5,293	
Minnesota, Wisconsin, etc	8,026	9.1				1,162		6,595	8.1				1,120	
Oklahoma, Kansas, etc	7,724	2.3				1,147		8,475	2.5				1,214	
Texas inland	5,695	3.7	1,784	10,471	2,127	355	68,200	8,573	5.6	1,784	11,805	666	373	92,371
Texas gulf coast	53,075	5.4				3,912		78,607	7.8				5,339	
Louisiana gulf coast	23,755	3.8				2,471		33,386	5.4				3,751	
Arkansas, Louisiana inland, etc	4,764	9.6				237		8,599	15.0				501	
New Mexico	1,166	6.9				91		2,837	18.4				108	
Rocky Mountain	9,864	6.5	252	--	--	831	9,456	12,396	8.0	252	2	--	935	12,452
West coast	132,900	18.1	3,512	4 20,075	6,114	11,822	157,015	124,154	18.0	2,137	21,665	4,137	13,016	143,085
Total or average	2 354,597	7.7	6,126	3 676,225	8,507	53,480	1,030,177	2 390,491	8.7	4,751	3 573,752	4,969	59,694	957,811

p Preliminary.

[1] Represents crude oil used as fuel on leases and for general industrial purposes.

[2] Sulfur content, in thousand barrels: 0%-0.50%, 1973—96,690, 1974—97,671; 0.51%-1.00%, 1973—82,500, 1974—103,358; 1.01%-2.00%, 1973—102,842, 1974—105,028; over 2.00%, 1973—72,565, 1974—84,434.

[3] Sulfur content, in thousand barrels: 0%-0.50%, 1973—245,740, 1974—196,234; 0.51%-1.00%, 1973—137,778; 1974—106,681; 1.01%-2.00%, 1973—73,745, 1974—75,745; over 2.00%, 1973—164,106, 1974—155,675.

[4] Includes foreign crude oil to be burned as fuel, in thousand barrels: PAD district I; 13,153; PAD district II, 1,916; PAD district V, 4,036.

[5] Includes foreign crude oil to be burned as fuel, in thousand barrels: PAD district I, 4,787; PAD district II, 2,721.

Table 35.—Salient statistics on petrochemical feedstocks [1] in the United States, by month and refining district

(Thousand barrels)

	Production				Imports	Exports (other)	Stocks, end of period			Domestic demand (all types)
	Still gas	Naphtha 400°	Other	Total			Naphtha 400°	Other	Total	
1973										
Month:										
January	1,327	4,780	4,821	10,928	318	235	964	1,654	2,618	11,159
February	840	4,751	4,495	10,086	580	721	1,065	1,783	2,848	9,715
March	1,183	4,509	5,270	10,962	191	270	1,253	1,804	3,057	10,674
April	1,019	4,815	5,337	11,171	324	338	1,396	1,633	3,029	11,185
May	1,222	3,943	5,040	10,205	216	476	1,128	1,609	2,737	10,237
June	1,054	4,329	5,572	10,955	358	675	1,077	1,782	2,859	10,516
July	916	4,655	5,468	11,039	214	662	954	1,684	2,638	10,812
August	1,188	4,648	5,351	11,187	429	675	851	1,509	2,360	11,219
September	1,015	4,816	4,998	10,829	171	451	908	1,348	2,256	10,653
October	884	5,106	5,620	11,610	331	839	1,059	1,561	2,620	10,738
November	902	5,066	5,548	11,516	279	716	918	1,524	2,442	11,257
December	878	5,737	5,461	12,076	414	781	1,012	1,375	2,387	11,764
Total	12,428	57,155	62,981	132,564	3,825	6,839	1,012	1,375	2,387	129,929
Refining district:										
East coast	919	4,932	30	5,881	359	602	--	--	--	9,626
Appalachian No. 1	23	--	738	761			--	12	12	
Appalachian No. 2	--	--	--	--	--	64	--	--	--	13,847
Indiana, Illinois, Kentucky, etc	2,128	4,373	2,304	8,805			187	116	303	
Minnesota, Wisconsin, etc	--	--	--	--			--	--	--	
Oklahoma, Kansas, etc	543	2,200	553	3,296			65	106	171	
Texas inland	432	1,768	3,578	5,778	3,466	3,371	1	182	183	99,568
Texas gulf coast	7,341	38,041	26,135	71,517			692	453	1,145	
Louisiana gulf coast	--	489	26,236	26,725			1	257	258	
Arkansas, Louisiana inland, etc	--	--	241	241			--	4	4	
New Mexico	--	--	--	--			--	--	--	
Rocky Mountain	161	--	34	195	--	18	--	--	--	216
West coast	881	5,352	3,132	9,365	--	2,784	66	245	311	6,672
Total	12,428	57,155	62,981	132,564	3,825	6,839	1,012	1,375	2,387	129,929

1974 ᵖ										
Month:										
January	1,263	4,728	4,176	10,167	701	287	983	1,223	2,206	10,762
February	877	4,921	4,675	10,478	481	512	1,085	1,577	2,662	9,986
March	799	5,189	4,242	10,230	323	535	1,473	1,260	2,733	9,947
April	795	4,409	4,192	9,896	362	343	1,528	1,138	2,666	8,982
May	889	4,954	4,176	10,019	196	286	1,583	1,329	2,912	9,683
June	1,232	5,258	4,660	11,150	83	548	1,727	1,450	3,177	10,420
July	1,184	6,263	5,567	13,014	255	769	1,915	1,280	3,195	12,482
August	1,308	5,948	5,447	12,703	167	446	1,618	1,486	3,104	12,515
September	1,298	5,250	5,087	11,635	443	496	1,528	1,452	2,980	11,706
October	1,464	5,269	5,301	12,034	421	359	1,600	1,482	3,082	11,994
November	1,246	5,330	5,368	11,989	571	181	1,724	1,574	3,298	12,113
December	2,020	5,049	4,985	12,004	361	299	1,898	1,588	3,486	11,878
Total	14,375	62,568	57,821	134,764	4,364	5,561	1,898	1,588	3,486	132,468
Refining district:										
East coast	792	5,456	482	6,730	941	772	--	189	189	11,161
Appalachian No. 1	62	--	742	804			--	7	7	
Appalachian No. 2	--	--	--	--	--	291	--	--	--	10,808
Indiana, Illinois, Kentucky, etc	2,664	3,777	1,954	8,895			192	115	307	
Minnesota, Wisconsin, etc	--	--	--	--			--	--	--	
Oklahoma, Kansas, etc	89	1,052	188	1,829			128	45	173	
Texas inland	300	3,308	3,468	7,076	3,423	2,668	33	231	264	104,380
Texas gulf coast	9,516	40,030	22,680	72,226			920	298	1,218	
Louisiana gulf coast	777	2,116	26,577	29,470			206	529	735	
Arkansas, Louisiana inland, etc	--	329	295	624			6	10	16	
New Mexico	--	--	--	--			--	--	--	
Rocky Mountain	121	--	--	121	--	28	--	--	--	114
West coast	54	6,500	1,435	7,989	--	1,802	413	164	577	6,005
Total	14,375	62,568	57,821	134,764	4,364	5,561	1,898	1,588	3,486	132,468

ᵖ Preliminary.

[1] Produced at petroleum refineries (excluding ethane and liquefied gases).

Table 36.—Salient statistics of special naphthas in the United States, by month and refining district

(Thousand barrels unless otherwise indicated)

	1973							1974 ᵖ						
	Production at refineries	Yield (percent)	Production at gas-processing plants	Imports	Exports	Total stocks, end of period	Domestic demand	Production at refineries	Yield (percent)	Production at gas-processing plants	Imports	Exports	Total stocks, end of period	Domestic demand
Month:														
January	2,742	0.7	19	7	169	5,038	2,798	2,809	0.8	15	5	127	4,556	2,667
February	2,320	.7	19	4	108	4,576	2,697	2,529	.8	14	162	131	4,462	2,668
March	2,802	.8	20	33	134	4,491	2,806	2,795	.8	16	151	99	4,595	2,730
April	2,499	.7	21	5	111	4,860	2,045	2,891	.8	16	256	117	4,627	3,014
May	2,697	.7	19	6	137	4,316	3,129	2,968	.8	16	277	135	4,872	2,881
June	2,673	.7	17	6	140	4,242	2,630	2,604	.7	15	—	139	4,901	2,451
July	3,126	.8	17	9	160	4,520	2,714	2,928	.7	16	1	85	4,944	2,817
August	2,867	.7	17	5	125	4,828	2,956	2,987	.7	15	1	118	4,959	2,820
September	2,720	.7	15	5	119	4,450	2,499	2,701	.7	14	1	72	5,001	2,602
October	2,977	.7	16	—	111	4,387	2,995	2,911	.8	13	82	131	5,038	2,843
November	2,628	.7	15	5	149	4,283	2,453	2,818	.8	13	1	81	5,398	2,391
December	2,822	.7	15	3	189	4,521	2,513	2,471	.6	12	1	65	5,720	2,092
Total or average	32,873	.7	210	88	1,652	4,521	32,230	33,362	.8	175	938	1,300	5,720	31,976
Refining district:														
East coast	123	--	--	6	400	878	7,479	27	--	--	2	229	1,117	7,485
Appalachian No. 1	268	.5	--			73		205	.8	--			50	
Appalachian No. 2	257	1.3	--	80	118	13	9,877	245	1.1	--	905	161	25	10,975
Indiana, Illinois, Kentucky, etc	4,563	.6	--			719		4,501	.6	--			801	
Minnesota, Wisconsin, etc	--	--	--			60		--	--	--			73	
Oklahoma, Kansas, etc	1,286	.4	--			110		2,473	.7	--			265	
Texas inland	1,425	.9	--	--	1,050	75	10,188	1,275	.8	--	--	823	145	8,004
Texas gulf coast	17,716	1.8	--			1,725		16,971	1.7	--			2,267	
Louisiana gulf coast	266	--	--			41		152	--	--			65	
Arkansas, Louisiana inland etc	1,603	3.2	210			157		1,898	3.3	175			242	
New Mexico	--	--	--			--		1	--	--			--	
Rocky Mountain	125	--	--	2	--	39	149	108	.1	--	--	4	22	149
West coast	5,241	.7	--	--	84	636	5,087	5,506	.8	--	31	83	648	5,413
Total or average	32,873	.7	210	88	1,652	4,521	32,230	33,362	.8	175	938	1,300	5,720	31,976

ᵖ Preliminary.

Table 37.—Salient statistics of lubricants in the United States, by month and refining district

(Thousand barrels unless otherwise indicated)

	Production				Yield (per-cent)	Im-ports (all types)	Ex-ports (all types)	Stocks, end of period				Domestic demand (all types)
	Bright stock	Neutral	Other grades	Total				Bright stock	Neutral	Other grades	Total	
1978												
Month:												
January	572	2,772	2,396	5,740	1.5	210	1,208	1,110	4,179	8,108	13,397	4,616
February	520	2,349	2,546	5,415	1.6	160	1,069	1,064	4,262	8,015	13,341	4,562
March	703	2,611	2,555	5,869	1.6	230	1,243	1,164	4,377	7,738	13,279	4,918
April	652	2,376	2,457	5,485	1.5	205	1,168	1,187	4,470	7,784	13,441	4,360
May	609	2,380	2,783	5,772	1.5	85	1,190	1,068	4,242	7,600	12,910	5,148
June	558	2,375	2,477	5,410	1.4	119	1,190	1,058	4,101	7,611	12,770	4,479
July	705	2,338	2,749	5,792	1.4	121	1,044	1,053	3,880	7,276	12,209	5,430
August	571	2,495	2,534	5,600	1.4	217	976	935	3,731	7,099	11,765	5,285
September	546	2,348	2,566	5,460	1.4	170	961	878	3,816	7,111	11,805	4,629
October	669	2,621	2,881	6,171	1.6	113	767	955	3,659	7,009	11,623	5,699
November	606	2,624	2,792	6,022	1.6	333	869	964	4,034	7,059	12,057	5,052
December	770	2,675	2,561	6,006	1.6	178	1,062	1,098	4,186	6,902	12,186	4,993
Total or average	7,481	29,964	31,297	68,742	1.5	2,091	12,747	1,098	4,186	6,902	12,186	59,171
Refining district:												
East coast	599	3,302	3,711	7,612	1.5	1,980	3,489	75	648	1,808	2,526	23,928
Appalachian No. 1	1,396	2,727	346	4,469	6.9			270	291	487	1,048	
Appalachian No. 2	--	--	--	--	--	1	476	--	--	48	48	14,281
Indiana, Illinois, Kentucky, etc	438	3,258	1,684	5,380	.6			69	579	787	1,435	
Minnesota, Wisconsin, etc	--	--	--	--	--			--	--	34	34	
Oklahoma, Kansas, etc	1,126	2,705	1,514	5,345	1.6			173	357	135	665	
Texas inland	--	--	108	108	.1	110	7,648	--	--	28	28	14,778
Texas gulf coast	1,932	8,577	19,612	30,121	3.0			266	1,084	2,521	3,871	
Louisiana gulf coast	662	6,039	1,185	7,886	1.3			60	821	225	1,106	
Arkansas, Louisiana inland etc	--	851	1,133	1,984	3.9			--	46	174	220	
New Mexico	--	--	--	--	--			--	--	4	4	
Rocky Mountain	44	176	167	387	.3	--	11	7	74	30	111	48
West coast	1,284	2,329	1,837	5,450	.7	--	1,128	178	286	631	1,095	6,146
Total or average	7,481	29,964	31,297	68,742	1.5	2,091	12,747	1,098	4,186	6,902	12,186	59,171

Table 37.—Salient statistics of lubricants in the United States, by month and refining district—Continued

(Thousand barrels unless otherwise indicated)

	Production				Yield (percent)	Imports (all types)	Exports (all types)	Stocks, end of period				Domestic demand (all types)
	Bright stock	Neutral	Other grades	Total				Bright stock	Neutral	Other grades	Total	
1974 ᵖ												
Month:												
January	621	2,661	2,591	5,873	1.6	210	1,023	1,162	4,253	6,601	12,016	5,230
February	517	2,319	2,356	5,192	1.6	171	676	1,167	4,278	6,898	12,343	4,360
March	605	2,757	2,745	6,107	1.8	215	1,021	1,220	4,311	7,198	12,729	4,915
April	610	2,586	2,817	6,013	1.7	118	1,206	1,303	4,301	7,353	12,957	4,697
May	694	2,570	2,810	6,074	1.6	108	1,184	1,300	4,084	7,360	12,744	5,211
June	537	2,695	2,854	6,086	1.6	239	1,020	1.366	4,515	8,075	13,956	4,093
July	474	2,621	2,882	5,977	1.5	139	1,279	1,202	4,492	8,102	13,796	4,997
August	648	2,676	2,690	6,014	1.5	137	1,010	1,279	4,868	8,275	14,422	4,515
September	624	2,670	2,500	5,794	1.6	150	799	1,443	5,102	8,153	14,698	4,869
October	684	2,592	2,665	5,941	1.6	153	918	1,438	5,182	8,241	14,861	5,013
November	576	2,676	2,554	5,806	1.6	90	988	1,435	5,346	8,633	15,414	4,355
December	614	2,540	2,663	5,817	1.5	56	812	1,603	5,509	8,948	16,060	4,415
Total or average	7,204	31,363	32,127	70,694	1.6	1.786	11,936	1,603	5,509	8,948	16,060	56,670
Refining district:												
East coast	719	2,502	4,265	7,486	1.5	1,547	3,210	170	666	2,754	3,590	22,784
Appalachian No. 1	1,388	2,833	391	4,612	7.6			431	322	589	1,342	
Appalachian No. 2	—	—	—	—	—	32	250	—	—	75	75	13,704
Indiana, Illinois, Kentucky, etc	341	3,051	1,772	5,164	.7			114	778	1,241	2,133	
Minnesota, Wisconsin, etc	—	—	—	—	—			—	—	31	31	
Oklahoma, Kansas, etc	733	3,031	1,731	5.495	1.7			116	485	199	800	
Texas inland	—	—	8	8	—	178	7,425	—	—	16	16	14,810
Texas gulf coast	2,122	9,755	19,671	31,548	3.1			295	1,551	2,682	4,528	
Louisiana gulf coast	560	6,391	1,326	8,277	1.4			108	1,109	396	1,613	
Arkansas, Louisiana inland etc	—	874	1,288	2,162	3.8			—	75	209	284	
New Mexico	—	—	—	—	—			—	—	3	3	
Rocky Mountain	45	291	86	422	.3	4	7	13	60	16	89	713
West coast	1,296	2,635	1,589	5,520	.8	80	1,044	356	463	737	1,556	4,659
Total or average	7,204	31,363	32,127	70,694	1.6	1,786	11,936	1,603	5,509	8,948	16,060	56,670

ᵖ Preliminary.

Table 38.—Salient statistics of wax in the United States, by type, month, and refining district

(Thousand barrels) [1]

	Production				Imports (all types)	Exports (all types)	Stocks, end of period				Domestic demand (all types)
	Microcrystalline	Crystalline, fully refined	Crystalline, other	Total			Microcrystalline	Crystalline, fully refined	Crystalline, other	Total	
1973											
Month:											
January	78	280	178	536	100	121	183	478	397	1,058	518
February	66	189	159	414	61	60	175	405	409	989	484
March	81	231	222	534	103	88	154	362	431	947	591
April	83	254	176	513	94	85	157	375	474	1,006	463
May	87	298	188	573	71	87	147	373	397	917	646
June	115	250	174	539	90	73	150	377	393	920	553
July	100	231	231	562	62	82	140	353	448	941	521
August	105	282	187	574	124	51	124	345	453	922	666
September	97	279	182	558	86	108	124	351	399	874	584
October	112	294	240	646	92	49	125	341	447	913	650
November	106	327	250	683	108	91	117	373	436	926	687
December	103	288	245	636	76	70	110	402	478	990	578
Total	1,133	3,203	2,432	6,768	1,067	965	110	402	478	990	6,941
Refining district:											
East coast	89	406	24	519	883	219	2	48	10	60	2,836
Appalachian No. 1	282	134	498	914			35	55	54	144	
Appalachian No. 2	--	--	--	--	36	39	--	--	--	--	1,167
Indiana, Illinois, Kentucky, etc	1	315	249	565			--	22	125	147	
Minnesota, Wisconsin, etc	--	--	--	--			--	--	--	--	
Oklahoma, Kansas, etc	293	257	79	629	132	636	31	42	8	81	
Texas inland	79	--	--	79			14	--	--	14	1,879
Texas gulf coast	145	605	1,127	1,877			15	39	213	267	
Louisiana gulf coast	42	744	146	932			10	138	21	169	
Arkansas, Louisiana inland, etc	194	--	--	194			1	--	--	1	
New Mexico	--	--	--	--			--	--	--	--	
Rocky Mountain	8	56	34	98	--	--	2	29	24	55	73
West coast	--	686	275	961	16	71	--	29	23	52	986
Total	1,133	3,203	2,432	6,768	1,067	965	110	402	478	990	6,941

See footnotes at end of table.

Table 38.—Salient statistics of wax in the United States, by type, month, and refining district—Continued

(Thousand barrels)[1]

	Production				Imports (all types)	Exports (all types)	Stocks, end of period				Domestic demand (all types)
	Microcrystalline	Crystalline, fully refined	Crystalline, other	Total			Microcrystalline	Crystalline, fully refined	Crystalline, other	Total	
1974[p]											
Month:											
January	90	298	181	569	99	54	107	374	428	909	695
February	90	235	190	515	73	62	107	360	455	922	513
March	103	296	195	594	90	114	115	386	367	868	624
April	103	248	241	592	75	75	117	379	408	904	556
May	105	263	235	603	101	63	120	387	438	945	600
June	93	262	284	639	85	72	130	415	461	1,006	591
July	95	237	275	607	86	78	133	406	458	997	624
August	98	293	289	680	114	91	134	447	496	1,077	623
September	84	235	221	540	46	36	130	447	537	1,114	513
October	104	231	247	582	59	55	144	446	549	1,139	561
November	82	217	216	515	62	61	159	457	531	1,147	508
December	89	217	187	493	66	118	179	501	515	1,195	393
Total	1,136	3,032	2,761	6,929	956	879	179	501	515	1,195	6,801
Refining district:											
East coast	78	362	18	458	847	137	8	55	17	80	2,105
Appalachian No. 1	142	70	390	602			52	8	82	142	
Appalachian No. 2	--	--	--	--	3	33	--	--	--	--	1,346
Indiana, Illinois, Kentucky, etc	--	232	184	416			--	11	133	144	
Minnesota, Wisconsin, etc	--	--	--	--			--	--	--	--	
Oklahoma, Kansas, etc	296	261	437	994			50	62	14	126	
Texas inland	87	--	--	87	88	629	20	--	--	20	2,048
Texas gulf coast	162	526	931	1,619			40	59	174	273	
Louisiana gulf coast	27	886	95	1,008			3	212	33	248	
Arkansas, Louisiana inland, etc	329	--	--	329			3	--	--	3	
New Mexico	--	--	--	--			--	--	--	--	
Rocky Mountain	14	68	29	111	--	--	3	41	19	63	100
West coast	1	627	677	1,305	18	80	--	53	43	96	1,202
Total	1,136	3,032	2,761	6,929	956	879	179	501	515	1,195	6,801

[p] Preliminary.

[1] Conversion factor: 280 pounds = 1 barrel.

Table 39.—Salient statistics of petroleum coke in the United States, by month and refining district

(Thousand barrels unless otherwise indicated)[1]

	1973							1974 p						
	Production							Production						
	Marketable	Catalyst	Total	Yield (percent)	Exports	Stocks, end of period	Domestic demand	Marketable	Catalyst	Total	Yield (percent)	Exports	Stocks, end of period	Domestic demand
Month:														
January	5,752	5,660	11,412	2.9	2,257	8,599	8,372	5,350	4,918	10,268	2.8	2,806	9,642	7,789
February	5,173	4,888	10,061	2.9	2,794	8,976	6,890	4,730	4,491	9,221	2.9	2,837	9,057	6,909
March	5,750	5,385	11,135	3.0	2,848	9,739	7,524	4,953	5,017	9,970	2.9	2,597	8,266	8,164
April	5,612	5,263	10,875	3.0	3,928	9,475	7,211	5,114	4,933	10,047	2.8	3,524	7,756	7,033
May	5,383	5,763	11,146	2.9	3,000	9,609	8,012	5,699	5,030	10,729	2.8	4,436	7,455	6,594
June	6,155	5,419	11,574	2.9	2,955	9,824	8,404	5,624	4,829	10,453	2.7	3,891	6,898	7,119
July	6,019	5,736	11,755	2.9	3,005	10,287	8,287	5,573	5,288	10,861	2.7	4,147	6,572	7,040
August	5,807	5,739	11,546	2.9	2,755	10,435	8,643	5,421	5,426	10,847	2.7	3,878	6,354	7,192
September	4,941	5,394	10,335	2.7	3,142	10,136	7,492	5,195	4,995	10,190	2.8	2,252	6,532	7,760
October	5,795	5,282	11,077	2.8	2,552	9,783	8,878	5,462	4,870	10,332	2.7	3,787	6,472	6,605
November	5,406	5,091	10,497	2.8	2,588	10,087	7,605	5,170	4,705	9,875	2.7	3,012	6,217	7,118
December	5,734	5,143	10,877	2.8	3,152	9,974	7,838	5,659	5,299	10,958	2.8	4,082	5,420	7,673
Total or average	67,527	64,763	132,290	2.9	34,976	9,974	95,156	63,950	59,796	123,746	2.8	41,244	5,420	87,056
Refining district:														
East coast	5,506	7,699	13,205	2.5	582	2,726	11,361	4,932	6,675	11,607	2.4	1,056	1,894	11,778
Appalachian No. 1	--	422	422	.6		--		--	395	395	.7		--	
Appalachian No. 2	--	289	289	1.4	2,176	--	35,852	--	349	349	1.6	2,572	--	35,596
Indiana, Illinois, Kentucky, etc	10,758	12,973	23,731	2.9		1,066		10,257	12,490	22,747	2.9		272	
Minnesota, Wisconsin, etc	1,964	1,654	3,618	4.0		685		1,190	1,382	2,572	3.2		--	
Oklahoma, Kansas, etc	6,217	5,018	11,235	3.4		582		6,008	4,653	10,661	3.2		222	
Texas inland	460	2,858	3,318	2.2	10,979	5	31,764	454	3,000	3,454	2.2	14,936	5	25,219
Texas gulf coast	8,355	15,363	23,718	2.4		396		8,199	14,204	22,403	2.2		48	
Louisiana gulf coast	8,828	5,750	14,578	2.8		111		8,322	4,714	13,036	2.1		148	
Arkansas, Louisiana inland, etc	438	202	640	1.3		49		445	298	743	1.3		58	
New Mexico	--	187	187	1.1		--		--	202	202	.9		--	
Rocky Mountain	1,316	2,667	3,983	2.6	8	1,825	3,953	1,192	2,662	3,854	2.5	7	1,651	4,021
West coast	23,685	9,686	33,371	4.5	21,231	2,529	12,226	22,951	8,772	31,723	4.6	22,678	1,137	10,442
Total or average	67,527	64,763	132,290	2.9	34,976	9,974	95,156	63,950	59,796	123,746	2.8	41,244	5,420	87,056

p Preliminary.

[1] Conversion factor: 5.0 barrels = 1 short ton.

Table 40.—Statistical summary of petroleum asphalt and road oil

(Thousand short tons) [1]

	1970	1971	1972	1973	1974 [p]
Petroleum asphalt:					
Production	26,665	28,553	28,285	30,524	29,861
Imports (including natural)	1,127	1,312	1,684	1,585	2,046
Exports	65	55	61	62	74
Stocks (end of period)	2,869	3,855	3,934	2,781	3,885
Apparent domestic consumption	27,905	28,823	29,779	33,200	30,679
Petroleum asphalt shipments:					
Paving	23,594	23,821	24,308	[r] 27,041	25,369
Roofing	4,248	4,362	5,347	5,677	5,035
All other	1,870	1,840	1,466	[r] 1,615	1,445
Total	29,712	30,023	31,121	[r] 34,333	31,849
Road oil:					
Production	1,708	1,592	1,444	1,332	1,302
Stocks (end of period)	115	164	237	145	196
Apparent domestic consumption	1,753	1,543	1,371	1,424	1,251
Road oil shipments	1,753	1,543	1,371	1,424	1,251

[p] Preliminary. [r] Revised.

[1] Converted from barrels to short tons (5.5 barrels = 1 short ton).

Table 41.—Salient statistics of petroleum asphalt in the United States, by month and refining district

(Thousand short tons) [1]

	1973					1974 p				
	Production	Imports (including natural)	Exports	Stocks, end of period	Domestic demand	Production	Imports (including natural)	Exports	Stocks, end of period	Domestic demand
Month:										
January	1,440	72	3	4,426	1,017	1,600	187	4	3,266	1,250
February	1,516	55	3	4,908	1,086	1,576	212	2	3,663	1,389
March	1,838	78	4	5,414	1,406	2,092	156	10	4,210	1,691
April	2,197	49	6	5,637	2,016	2,374	250	13	4,626	2,195
May	2,673	124	5	5,499	2,929	2,672	477	13	4,687	3,075
June	3,054	68	5	4,969	3,647	2,934	140	6	4,462	3,293
July	3,216	238	5	4,158	4,260	3,204	118	9	4,128	3,647
August	3,441	203	6	3,047	4,750	3,143	119	5	3,680	3,705
September	3,291	207	6	2,709	3,830	2,841	117	2	3,141	3,493
October	3,240	133	8	2,267	3,808	3,052	134	2	2,801	3,524
November	2,551	132	5	2,192	2,753	2,412	76	4	3,092	2,193
December	2,067	176	6	2,731	1,698	1,961	60	4	3,885	1,224
Total	30,524	1,535	62	2,731	33,200	29,861	2,046	74	3,885	30,679
Refining district:										
East coast	6,243	1,471	7	721	9,388	5,886	1,961	11	907	8,960
Appalachian No. 1	378			48		271			63	
Appalachian No. 2	307			66		248	7	6	133	10,231
Illinois, Indiana, Kentucky, etc	6,084	14	7	415	11,673	6,126			824	
Minnesota, Wisconsin, etc	1,367			108		1,081			153	
Oklahoma, Kansas, etc	2,722			253		2,685			314	
Texas inland	1,376	50	8	111	6,072	1,310	76	29	160	5,583
Texas gulf coast	1,714			124		1,759			137	
Louisiana gulf coast	2,678			133		2,651			250	
Arkansas, Louisiana inland, etc	1,618			115		1,632			170	
New Mexico	147			20		165			41	
Rocky Mountain	1,888	--	1	231	2,230	1,798	--	3	300	1,793
West coast	4,002	--	39	386	3,837	4,249	2	25	433	4,112
Total	30,524	1,535	62	2,731	33,200	29,861	2,046	74	3,885	30,679

p Preliminary.

[1] Converted from barrels to short tons (5.5 barrels = 1 short ton).

Table 42.—Salient statistics of road oil in the United States, by month and refining district

(Short tons)[1]

	1973			1974 [p]		
	Production	Stocks, end of period	Domestic demand	Production	Stocks, end of period	Domestic demand
Month:						
January	34,909	253,818	18,364	42,546	166,909	20,909
February	34,909	272,000	16,727	60,727	202,727	24,909
March	86,546	323,818	34,727	98,727	273,091	28,364
April	100,909	380,727	44,000	107,455	318,364	62,182
May	120,364	366,182	134,909	128,545	359,818	87,091
June	190,182	329,818	226,546	151,818	339,273	172,364
July	181,636	279,091	232,364	194,545	316,000	217,818
August	203,091	202,182	280,000	184,727	299,091	201,636
September	161,818	188,182	175,818	128,364	254,182	173,273
October	123,278	157,455	154,000	101,636	183,273	172,545
November	55,454	131,455	81,454	50,546	159,818	74,000
December	38,909	145,273	25,091	52,546	196,364	16,000
Total	1,332,000	145,273	1,424,000	1,302,182	196,364	1,251,091
Refining district:						
East coast	--	--	119,818	--	--	74,546
Appalachian No. 1	128,364	11,637		64,545	1,636	
Appalachian No. 2	--	--		--	--	
Indiana, Illinois, Kentucky, etc	514,182	23,273	787,637	564,727	51,091	712,727
Minnesota, Wisconsin, etc	--	--		16,546	--	
Oklahoma, Kansas, etc	232,000	9,818		158,546	9,091	
Texas inland	11,636	--	11,636	4,364	--	8,182
Texas gulf coast	--	--		--	--	
Louisiana gulf coast	--	--		--	--	
Arkansas, Louisiana inland, etc	--	--		3,818	--	
New Mexico	--	--		--	--	
Rocky Mountain	140,000	3,818	150,909	97,454	3,273	98,000
West coast	305,818	96,727	354,000	392,182	131,273	357,636
Total	1,332,000	145,273	1,424,000	1,302,182	196,364	1,251,091

[p] Preliminary.

[1] Converted from barrels to short tons (5.5 barrels = 1 short ton).

Table 43.—Production of miscellaneous finished oils at refineries and natural gas processing plants in the United States in 1974, by refining district and class

(Thousand barrels)

District	Absorption	Petrolatum	Specialty oils[1]	Petrochemicals	Other products[2]	Total
East coast	--	54	1,140	1,281	8	2,483
Appalachian No. 1	3	111	40	11	2,105	2,270
Appalachian No. 2	--	--	47	23	--	70
Indiana, Illinois, Kentucky, etc	74	21	625	830	307	1,857
Minnesota, Wisconsin, etc	--	--	--	9	--	9
Oklahoma, Kansas, etc	108	153	320	--	335	916
Texas inland	182	--	1,085	277	156	1,700
Texas gulf coast	39	335	1,453	3,578	165	5,570
Louisiana gulf coast	353	80	383	6,521	535	7,872
Arkansas, Louisiana inland, etc	50	--	26	104	--	180
Rocky Mountain and New Mexico	3	32	--	33	10	78
West coast	6	56	1,208	840	131	2,241
Total:						
1974	818	842	6,327	13,507	3,752	25,246
1973	1,179	809	7,056	8,905	1,912	19,861

[1] Specialty oils include hydraulic, 245; insulating, 450; medicinal, 341; rust preventatives, 30; sand-frac, 1,085; spray oils, 345; and other, 3,831.

[2] Includes SNG feedstock.

Table 44.—Receipts of domestic and foreign crude petroleum at refineries in the United States

(Million barrels)

Method of transportation	1970	1971	1972	1973	1974 [p]
By water:					
Intrastate	148.2	160.9	155.4	148.9	130.4
Interstate	461.8	430.0	298.5	249.8	211.5
Foreign	244.0	352.6	490.5	775.3	896.1
Total by water	854.0	943.5	944.4	1,174.0	1,238.0
By pipeline:	1,730.5	1,702.2	1,832.0	1,796.9	1,692.5
Intrastate	1,109.4	1,132.3	1,131.8	1,108.1	1,061.4
Interstate	236.8	260.4	317.8	408.7	370.7
Foreign					
Total by pipeline	3,076.7	3,094.9	3,281.6	3,313.7	3,124.6
By tank cars and trucks:					
Intrastate	37.1	37.0	47.5	45.7	51.7
Interstate	5.5	5.4	5.7	12.4	22.0
Foreign	--	--	--	--	--
Total by tank cars and trucks	42.6	42.4	53.2	58.1	73.7
Grand total	3,973.3	4,080.8	4,279.2	4,545.8	4,436.3

[p] Preliminary.

Table 45.—Interdistrict movement by tanker and barge of crude oil and petroleum products in 1974, by month

(Thousand barrels)

Item	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total	1973 total
Gulf coast to east coast, total:[1]														
Crude oil	5,245	9,515	8,551	3,948	3,254	3,616	3,240	3,341	3,249	3,134	2,914	2,330	52,337	56,614
Unfinished oils	2,448	781	4,178	848	1.046	1,115	1.845	778	1,805	1,277	918	1,089	18,128	14,797
Gasoline:														
Motor	12,666	13,324	12,651	13,551	15,667	14,809	16,429	15,730	15,056	13,080	17,312	16,633	176,908	204,258
Aviation	151	140	171	170	303	362	245	269	373	271	259	266	2,980	3,216
Total gasoline	12,817	13,464	12,822	13,721	15,970	15,171	16,674	15,999	15,429	13,351	17,571	16,899	179,888	207,474
Special naphthas	780	534	541	691	582	747	612	562	632	592	692	681	7,646	7,192
Kerosine	1,175	713	1,191	476	546	849	982	953	665	1,029	1,076	1,224	10,879	15,078
Distillate fuel oil	6,711	7,756	6,301	8,078	9.504	6,099	6,334	5,643	6,291	7,480	10,068	13,195	93,460	r 96,283
Residual fuel oil	1,565	1.887	2,207	3,202	2,969	2,961	3,692	3,462	2,934	3,871	3,961	3,812	36,023	r 16,960
Jet fuel:														
Naphtha-type	709	959	888	1,094	1,425	1,132	376	416	589	642	643	608	9,481	9,480
Kerosine-type	2,267	1,985	2,477	2,399	3,318	1,850	1,484	2,694	2,379	2,184	2,493	2,464	27,994	31,554
Total jet fuel	2,976	2,944	3,365	3,493	4,743	2,982	1,860	3,110	2,968	2,826	3,136	3,072	37,475	41,034
Lubricating oil	1,019	1,129	1,062	1,490	971	758	1,034	1,049	908	966	1,402	1,134	12,922	12,342
Wax	10	29	22	27	30	22	24	20	3	123	28	15	353	578
Asphalt and road oil	486	360	533	538	925	621	355	388	393	393	440	364	5,796	5,689
Liquefied gases	157	41	117	95	83	14	35	64	555	125	111	144	1,541	1,304
Petrochemical feedstocks	338	399	313	441	276	306	301	343	403	234	211	192	3,757	3,226
Other products	172	463	72	67	126	216	244	162	259	195	222	338	2,536	1,654
Total	35,899	40,015	41,275	37,115	41,025	35,477	37,232	35,874	36,494	35,596	42,750	43,989	462,741	480,220
Gulf coast to PAD district II:														
Crude oil	986	821	1,052	928	1,084	1,110	1,176	1,029	1,249	1,096	1,300	1,010	12,841	10,250
Unfinished oils	--	--	--	--	8	--	--	51	--	--	--	--	59	120
Gasoline:														
Motor	2,185	1,331	2,344	2,568	2,567	2,172	2,289	2,560	2,011	1,746	2,614	2,470	27,357	31,998
Aviation	48	17	70	24	45	47	38	40	65	67	45	27	533	732
Total gasoline	2,233	1,848	2,414	2,592	2,612	2,219	2,327	2,600	2,076	1,813	2,659	2,497	27,890	32,730
Special naphthas	285	291	265	284	357	264	285	167	286	301	238	252	3,275	3,187
Kerosine	152	163	90	72	58	--	60	--	73	--	96	--	764	956
Distillate fuel oil	553	678	526	611	617	490	418	518	420	474	524	620	6,449	r 9,224
Residual fuel oil	779	863	1,356	745	1,101	991	927	816	1,285	1,336	1,284	1,776	13,209	r 10,523

Jet fuel:														
Naphtha-type	--	41	92	94	--	--	--	--	--	--	--	--	227	14
Kerosine-type	239	136	321	159	217	285	117	155	172	219	175	276	2,471	2,612
Total jet fuel	239	177	413	253	217	285	117	155	172	219	175	276	2,698	2,626
Lubricating oil	260	193	404	378	404	400	418	381	320	328	310	329	4,125	3,692
Wax	--	--	--	--	--	--	--	--	8	--	--	--	8	--
Asphalt and road oil	62	146	197	258	271	449	439	578	484	470	212	118	3,684	3,523
Liquefied gases	--	53	--	--	--	--	--	--	--	--	18	--	71	654
Petrochemical feedstocks	190	151	106	135	127	90	109	101	47	149	78	98	1,381	1,872
Other products	51	28	68	140	86	64	95	128	308	93	11	23	1,095	993
Total	5,790	5,417	6,891	6,396	6,942	6,362	6,366	6,524	6,728	6,279	6,850	7,004	77,549	80,350
Gulf coast to west coast:														
Crude oil	283	--	281	--	--	--	--	--	--	--	--	--	564	--
Unfinished oils	--	--	--	--	--	--	--	--	--	288	--	--	288	372
Motor gasoline	--	67	666	334	325	--	--	--	--	--	--	--	1,392	675
Kerosine	--	--	--	--	--	--	--	--	--	--	--	--	--	36
Distillate fuel oil	407	247	--	669	289	611	--	--	10	--	--	46	2,279	687
Residual fuel oil	316	--	--	--	--	--	--	--	--	--	--	--	316	1,898
Jet fuel:														
Naphtha-type	72	--	67	350	--	--	--	--	--	--	--	--	489	110
Kerosine-type	--	--	194	523	--	91	312	--	271	141	--	--	1,532	691
Total jet fuel	72	--	261	873	--	91	312	--	271	141	--	--	2,021	801
Lubricating oil	241	64	181	111	217	20	177	115	171	88	35	251	1,671	1,491
Petrochemical feedstocks	--	23	--	--	--	--	8	--	25	23	--	26	105	4
Other products	--	--	2	--	6	--	7	--	--	--	--	--	15	105
Total	1,319	401	1,391	1,987	837	722	504	115	477	540	35	323	8,651	6,069
West coast to east coast:														
Special naphthas	--	--	--	--	--	--	--	--	--	--	--	--	--	4
Lubricating oil	54	83	83	28	78	62	102	65	12	89	41	88	785	690
Other products	26	30	45	45	35	19	41	11	19	15	16	22	324	242
Total	80	113	128	73	113	81	143	76	31	104	57	110	1,109	936

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r Revised.

[1] Breakdown by region shown in table 46.

Table 46.—Tanker and barge movements of crude oil and petroleum products from the gulf coast to the east coast in 1974, by region and month

(Thousand barrels)

Item	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total	1973 total
To New England:														
Gasoline:														
Motor	1,494	1,646	1,517	1,228	2,119	1,833	2,027	2,633	2,575	1,557	2,879	2,576	24,084	35,175
Aviation	3	--	--	9	21	108	26	65	37	21	35	32	357	477
Total gasoline	1,497	1,646	1,517	1,237	2,140	1,941	2,053	2,698	2,612	1,578	2,914	2,608	24,441	35,652
Special naphthas	42	33	94	35	46	27	58	27	78	35	23	29	527	567
Kerosine	236	173	132	31	36	123	164	179	163	158	189	231	1,815	2,824
Distillate fuel oil	2,656	4,132	2,945	2,646	3,181	1,892	1,733	1,472	2,308	2,939	4,324	4,387	34,610	38,600
Residual fuel oil	555	899	312	390	751	536	994	921	242	1.624	537	88	7,849	4,261
Jet fuel:														
Naphtha-type	26	666	--	--	--	70	54	--	--	--	--	--	516	1,080
Kerosine-type	425	529	474	256	881	443	357	507	524	395	495	387	5,623	6,658
Total jet fuel	451	895	474	256	881	513	411	507	524	395	495	387	6,139	7,738
Lubricating oil	11	31	9	336	50	3	23	29	14	40	35	26	612	432
Asphalt and road oil	--	--	--	--	123	1	--	--	--	--	--	--	124	--
Petrochemical feedstocks	--	20	--	8	5	9	--	--	8	--	--	8	58	310
Other products	--	--	--	2	10	--	14	3	18	--	1	--	48	62
Total	5,448	7,829	5,483	4,941	7,173	5,050	5,450	5,836	5,962	6,769	8,518	7,764	76,223	90,446
To Central Atlantic:														
Crude oil	5,045	9,485	8,531	3,908	3,286	3,616	3,240	3,341	3,210	3,184	2,914	2,330	51,990	55,909
Unfinished oils	2,419	752	4,126	794	1,046	1,115	1,845	778	1,805	970	918	161	16,729	14,555
Gasoline:														
Motor	3,502	2,375	2,327	3,666	4,694	4,807	5,198	4,353	4,557	4,451	6,303	5,411	51,644	58,878
Aviation	28	34	40	76	46	69	71	83	89	94	68	69	767	913
Total gasoline	3,530	2,409	2,367	3,742	4,740	4,876	5,269	4,436	4,646	4,545	6,371	5,480	52,411	59,791
Special naphthas	382	227	287	448	386	516	402	324	457	401	487	479	4,796	4,349
Kerosine	573	271	674	210	239	424	567	480	154	613	522	670	5,397	5,814
Distillate fuel oil	1,074	1,330	1,169	3,148	3,273	1,753	2,331	1,796	1,032	1,691	3,485	5,589	27,671	r 27,269
Residual fuel oil	662	656	1,685	2,316	1,724	1,574	1,992	1,637	2,055	1.852	2.481	2,155	20,739	r 8,028

Jet fuel:													
Naphtha-type	—	73	—	61	—	142	—	—	93	—	75	—	444	1,178
Kerosine-type	578	231	404	643	499	283	334	629	651	519	376	593	5,740	8,915
Total jet fuel	578	304	404	704	499	425	334	629	744	519	451	593	6,184	10,088
Lubricating oil	810	873	874	914	799	617	909	796	768	723	1,145	979	10,207	10,015
Wax	10	29	22	26	30	22	24	20	3	123	28	15	352	429
Asphalt and road oil	39	—	34	—	67	32	25	25	56	13	—	—	291	303
Liquefied gases	—	—	—	—	—	—	—	—	492	—	—	—	492	—
Petrochemical feedstocks	235	266	313	376	257	245	301	329	395	200	176	177	3,270	2,177
Other products	117	383	37	17	56	159	164	109	179	141	146	160	1,668	1,005
Total	15.474	16,985	20,523	16,603	16.352	15.374	17.403	14,700	15,996	14.925	19.074	18,788	202,197	199,732
To Lower Atlantic:														
Crude oil	200	30	20	40	18	—	—	—	39	—	—	—	347	705
Unfinished oils	29	29	52	54	—	—	—	—	—	307	—	928	1,399	242
Gasoline:														
Motor	7,670	9,303	8,807	8,657	8,854	8,169	9,204	8,744	7,924	7,072	8,130	8,646	101,180	110,205
Aviation	120	106	131	85	236	185	148	121	247	156	156	165	1,856	1,826
Total gasoline	7,790	9,409	8,938	8,742	9,090	8,354	9,352	8,865	8,171	7,228	8,286	8,811	103,036	112,031
Special naphthas	356	274	160	208	150	204	152	211	97	156	182	173	2,323	2,276
Kerosine	366	269	385	235	271	302	251	294	348	258	365	323	3,667	6,440
Distillate fuel oil	2,981	2,294	2,187	2,284	3,050	2,454	2,270	2,375	2,956	2,850	2,259	3,219	31,179	r 30,414
Residual fuel oil	348	332	210	496	494	851	706	904	637	395	993	1,069	7,435	r 4,671
Jet fuel:														
Naphtha-type	683	520	888	1,033	1,425	920	322	416	496	642	568	608	8,521	7,227
Kerosine-type	1,264	1,225	1,599	1,500	1,988	1,124	793	1,558	1,204	1,270	1,622	1,484	16,631	15,981
Total jet fuel	1,947	1,745	2,487	2,533	3,413	2,044	1,115	1,974	1,700	1,912	2,190	2,092	25,152	23,208
Lubricating oil	198	225	179	240	122	133	102	224	126	203	222	129	2,103	1,895
Wax	—	—	—	1	—	—	—	—	—	—	—	—	1	144
Asphalt and road oil	447	360	499	538	735	588	330	363	337	380	440	364	5,381	5,386
Liquefied gases	157	41	117	95	83	14	35	64	63	125	111	144	1,049	1,304
Petrochemical feedstocks	103	113	—	57	14	52	—	14	—	34	35	7	429	739
Other products	55	80	35	48	60	57	66	50	62	54	75	178	820	587
Total	14,977	15,201	15,269	15,571	17,500	15,053	14,379	15,338	14,536	13,902	15,158	17,437	184,321	190,042

r **Revised.**

Table 47.—Transportation of petroleum products by pipeline between PAD districts in the United States in 1974, by month

(Thousand barrels)

Product	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total	1973 total
From district I to district II:														
Gasoline:														
Motor	3,533	2,528	3,710	3,447	4,317	4,171	4,430	3,840	4,002	4,239	3,958	3,811	45,986	45,385
Aviation	--	--	6	--	7	5	3	7	4	7	--	7	46	53
Total gasoline	3,533	2,528	3,716	3,447	4,324	4,176	4,433	3,847	4,006	4,246	3,958	3,818	46,032	45,438
Jet fuel:														
Naphtha-type	73	39	125	65	--	--	--	--	--	--	--	--	302	595
Kerosine-type	169	229	124	75	49	63	84	65	176	144	158	148	1,484	2,017
Total jet fuel	242	268	249	140	49	63	84	65	176	144	158	148	1,786	2,612
Kerosine	30	7	24	10	12	4	5	68	17	26	30	37	270	403
Distillate fuel oil	891	970	837	843	921	994	932	883	1,091	1,008	1,101	1,134	11,605	11,662
From district II to district I:														
Gasoline (motor)	829	865	1,711	1,022	1,170	922	983	1,218	991	842	912	975	12,440	10,066
Jet fuel (naphtha-type)	--	--	--	--	--	--	--	--	--	--	--	--	--	57
Kerosine	--	--	10	10	--	--	--	--	--	--	4	21	45	49
Distillate fuel oil	67	87	101	123	38	59	98	153	11	132	151	147	1,167	980
Natural gas liquids	730	758	602	1,283	980	834	660	614	1,013	704	770	1,403	10,351	11,910
From district II to district III:														
Gasoline (motor)	1,540	1,424	2,763	1,304	1,487	1,651	1,677	1,641	1,489	1,391	1,556	1,659	19,582	18,591
Jet fuel:														
Naphtha-type	--	40	40	40	50	49	82	50	48	84	30	--	513	41
Kerosine-type	1	1	--	1	1	--	1	--	1	--	--	1	7	6
Total jet fuel	1	41	40	41	51	49	83	50	49	84	30	1	520	47
Distillate fuel oil	405	419	844	504	489	400	404	472	486	515	44	484	5,466	4,748
Natural gas liquids	313	266	335	339	381	300	366	320	276	319	307	364	3,886	3,267
From district I to district IV:														
Gasoline (motor)	235	176	142	110	122	147	197	278	259	250	257	242	2,415	674
Distillate	49	39	31	23	33	95	60	78	48	46	42	41	585	92
From district III to district I:														
Gasoline:														
Motor	22,903	20,272	25,432	27,133	28,957	28,487	29,200	24,654	29,653	28,418	26,973	28,983	321,065	329,616
Aviation	16	--	40	--	18	16	39	17	16	29	--	15	206	219
Total gasoline	22,919	20,272	25,472	27,133	28,975	28,503	29,239	24,671	29,669	28,447	26,973	28,998	321,271	329,835
Jet fuel:														
Naphtha-type	75	95	60	136	188	115	109	96	174	100	133	142	1,423	747
Kerosine-type	4,735	4,581	4,388	3,837	3,641	3,438	3,069	3,582	4,192	4,883	4,933	4,673	49,952	54,757
Total jet fuel	4,810	4,676	4,448	3,973	3,829	3,553	3,178	3,678	4,366	4,983	5,066	4,815	51,375	55,504
Kerosine	1,152	978	788	566	265	367	539	434	545	668	838	1,007	8,147	11,184
Distillate fuel oil	19,454	17,517	13,087	14,112	15,928	13,971	13,645	9,995	11,864	14,802	14,110	14,932	173,417	180,331
Natural gas liquids	1,405	1,274	1,160	765	522	891	1,397	1,417	1,543	1,642	1,383	2,447	15,846	18,112

From district III to district II:													
Gasoline:													
Motor	4,601	4,606	4,913	4,771	4,861	5,733	5,460	8,266	6,665	5,213	6,217	3,948	65,254	63,660
Aviation	81	81	44	41	93	143	90	223	65	176	116	114	1,267	1,197
Total gasoline	4,682	4,687	4,957	4,812	4,954	5,876	5,550	8,489	6,730	5,389	6,333	4,062	66,521	64,857
Jet fuel:													
Naphtha-type	1	--	--	--	--	--	64	2	--	--	2	--	69	3
Kerosine-type	281	330	364	132	161	15	417	222	147	441	452	147	3,109	4,611
Total jet fuel	282	330	364	132	161	15	481	224	147	441	454	147	3,178	4,614
Kerosine	159	41	46	148	45	121	59	10	603	584	202	25	2,043	2,505
Distillate fuel oil	1,972	1,572	902	710	1,411	1,147	4,331	3,274	1,685	3,187	2,972	1,925	25,088	30,938
Natural gas liquids	8,642	5,741	5,897	5,237	5,512	5,365	4,597	5,444	5,444	6,791	7,765	9,141	75,576	71,698
From district III to district IV:													
Gasoline:													
Motor	246	215	235	254	647	675	619	646	397	424	452	336	5,146	4,499
Aviation	19	16	17	10	12	12	15	15	10	14	8	11	159	260
Total gasoline	265	231	252	264	659	687	634	661	407	438	460	347	5,305	4,759
Jet fuel (kerosine-type)	331	288	286	278	313	346	351	390	291	301	309	340	3,824	4,175
Kerosine	1	--	--	--	--	--	--	--	--	--	--	--	1	4
Distillate fuel oil	54	40	39	41	47	45	43	44	42	60	46	61	562	688
Natural gas liquids	178	92	82	75	40	24	34	45	67	67	106	153	963	1,259
From district III to district V:													
Gasoline (motor)	977	804	956	1,046	1,105	975	1,125	1,059	1,056	1,028	1,028	1,031	12,190	11,878
Jet fuel:													
Naphtha-type	50	24	47	111	73	118	52	36	81	90	90	122	894	652
Kerosine-type	127	105	104	86	116	104	95	89	89	109	109	119	1,252	1,056
Total jet fuel	177	129	151	197	189	222	147	125	170	199	199	241	2,146	1,708
Distillate fuel oil	442	380	302	318	335	430	296	333	334	446	446	419	4,481	4,532
From district IV to district II:													
Gasoline (motor)	337	334	316	307	411	462	549	546	489	446	361	462	5,020	4,552
Jet fuel:													
Naphtha-type	23	29	29	29	27	16	12	46	33	41	60	44	389	310
Kerosine-type	--	3	2	5	8	6	5	5	8	12	7	--	61	--
Total jet fuel	23	32	31	34	35	22	17	51	41	53	67	44	450	310
Kerosine	10	--	--	--	--	--	--	--	--	--	--	9	19	59
Distillate fuel oil	333	308	299	348	312	374	335	209	257	275	321	349	3,720	3,304
Natural gas liquids	--	--	--	5	3	4	2	--	--	--	--	--	14	--
From district IV to district III:													
Natural gas liquids	250	246	290	314	368	373	371	381	341	277	252	288	3,751	r 3,699
From district IV to district V:													
Gasoline (motor)	883	712	1,116	908	1,024	996	1,037	841	769	677	715	862	10,540	7,805
Jet fuel:													
Naphtha-type	49	28	96	102	143	98	95	14	56	50	59	72	862	351
Kerosine-type	54	68	51	60	58	36	100	47	76	42	53	59	704	477
Total jet fuel	103	96	147	162	201	134	195	61	132	92	112	131	1,566	828
Distillate fuel oil	445	444	328	396	326	420	330	454	240	414	340	714	4,851	3,672

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Table 48.—Transportation of petroleum products by pipelines in the United States in 1974, by month

(Thousand barrels)

Product	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total	1973 total
Turned into lines:														
Gasoline:														
Motor	132,729	119,674	141,009	141,258	157,565	155,587	160,612	159,592	150,126	153,315	148,111	149,840	1,769,418	1,755,306
Aviation	268	278	288	306	380	442	450	595	415	443	337	331	4,533	4,016
Total gasoline	132,997	119,952	141,297	141,564	157,945	156,029	161,062	160,187	150,541	153,758	148,448	150,171	1,773,951	1,759,322
Jet fuel:														
Naphtha-type	1,226	1,412	2,964	3,274	3,158	2,828	2,973	3,032	3,332	3,116	3,146	2,768	33,229	15,112
Kerosine-type	19,730	16,385	17,671	16,327	16,715	15,609	18,175	17,906	18,883	19,774	19,564	18,347	215,086	234,509
Total jet fuel	20,956	17,797	20,635	19,601	19,873	18,437	21,148	20,938	22,215	22,890	22,710	21,115	248,315	249,621
Kerosine	5,136	4,559	3,318	2,158	2,102	1,923	1,975	1,611	2,639	3,429	3,500	3,601	35,941	46,883
Distillate fuel oil	74,801	57,759	51,712	51,343	59,241	52,875	57,158	48,744	56,281	60,487	61,999	69,398	701,798	727,019
Natural gas liquids	38,224	34,279	38,111	37,249	38,858	34,512	38,392	40,681	39,476	40,776	41,995	44,727	467,280	438,000
Delivered from lines:														
Gasoline:														
Motor	132,632	117,535	140,548	140,771	157,108	156,367	160,615	158,315	152,465	155,316	148,066	150,436	1,770,174	1,756,721
Aviation	254	250	394	260	365	306	561	464	436	439	280	315	4,324	3,859
Total gasoline	132,886	117,785	140,942	141,031	157,473	156,673	161,176	158,779	152,901	155,755	148,346	150,751	1,774,498	1,760,580
Jet fuel:														
Naphtha-type	1,329	1,357	2,592	3,176	3,329	2,912	3,095	2,840	3,412	3,062	3,163	2,777	33,044	15,337
Kerosine-type	18,763	16,159	17,159	16,354	16,782	16,101	17,409	17,237	18,837	18,930	19,494	18,450	211,675	231,698
Total jet fuel	20,092	17,516	19,751	19,530	20,111	19,013	20,504	20,077	22,249	21,992	22,657	21,227	244,719	247,035
Kerosine	5,135	4,788	3,739	2,391	2,177	1,521	1,768	1,688	2,319	3,111	3,569	3,616	35,822	45,086
Distillate fuel oil	74,467	63,754	55,172	53,151	57,632	50,272	53,177	48,633	53,877	61,390	60,764	69,861	701,650	720,997
Natural gas liquids	39,088	34,778	38,262	38,283	37,330	34,141	39,525	40,355	38,126	41,169	42,107	45,408	468,567	431,228
Shortage or overage:[1]														
Gasoline:														
Motor	(99)	(454)	(329)	(550)	(64)	258	(186)	(7)	312	(413)	165	357	(1,010)	(2,586)
Aviation	(6)	(2)	24	3	23	(1)	(250)	306	51	(2)	(5)	4	145	161
Total gasoline	(105)	(456)	(305)	(547)	(41)	257	(436)	299	363	(415)	160	361	(865)	(2,425)
Jet fuel:														
Naphtha-type	1	15	48	(72)	(20)	(39)	(60)	(40)	(3)	28	15	(8)	(135)	(100)
Kerosine-type	196	289	413	265	324	104	374	188	341	274	182	390	3,340	2,669
Total jet fuel	197	304	461	193	304	65	314	148	338	302	197	382	3,205	2,569
Kerosine	127	87	7	(1)	32	102	73	58	115	85	80	119	884	1,608
Distillate fuel oil	(103)	(304)	(416)	(121)	5	564	219	(97)	(275)	(397)	397	(25)	(553)	(847)
Natural gas liquids	(18)	272	(101)	(418)	111	61	5	(12)	234	3	(253)	(183)	(299)	1,402

Stocks in lines and working tanks at end of month:														
Gasoline:														
Motor	45,163	47,756	48,546	49,583	50,104	49,066	49,249	50,533	47,882	46,294	46,174	45,221	45,221	44,967
Aviation	209	239	109	152	144	281	420	245	173	179	241	253	253	189
Total gasoline	45,372	47,995	48,655	49,735	50,248	49,347	49,669	50,778	48,055	46,473	46,415	45,474	45,474	45,156
Jet fuel:														
Naphtha-type	472	512	836	1,006	855	810	748	980	903	929	897	896	896	576
Kerosine-type	6,018	5,955	6,054	5,762	5,371	4,775	5,167	5,648	5,353	5,923	5,811	5,318	5,318	5,247
Total jet fuel	6,490	6,467	6,890	6,768	6,226	5,585	5,915	6,628	6,256	6,852	6,708	6,214	6,214	5,823
Kerosine	2,511	2,195	1,762	1,525	1,418	1,718	1,852	1,717	1,922	2,155	2,006	1,872	1,872	2,637
Distillate fuel oil	32,851	27,160	24,116	22,429	24,038	26,072	29,834	30,042	32,721	32,215	33,053	33,115	33,115	32,414
Natural gas liquids	20,719	19,948	19,898	19,282	20,699	21,009	19,871	20,209	21,325	20,929	21,070	20,577	20,577	21,565

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[1] **Figures in parentheses denote shortage.**

Table 49.—Pipeline tariff rates for crude petroleum and products, January 1

(Cents per barrel)

Origin	Destination	1974	1975
Crude oil:			
West Texas	Houston, Tex	$0.16–$0.18	$0.23
Do	East Chicago, Ind	29	36
Do	Wood River, Ill	29	36
Oklahoma	Chicago, Ill	23	26
Do	Wood River, Ill	19	21
Eastern Wyoming	Chicago, Ill	35	33
Do	Wood River, Ill	32	35
Refined products:			
Houston, Tex	Atlanta, Ga	33	53
Do	New York, N.Y	35	45
Tulsa, Okla	Minneapolis, Minn	74	77
Salt Lake City, Utah	Spokane, Wash	54	54
Philadelphia, Pa	Rochester, N.Y	25	45

Source: Interstate Commerce Commission.

Table 50.—Stocks of crude petroleum, natural gas liquids, and refined products in the United States at yearend

(Thousand barrels)

	1970	1971	1972	1973	1974
Crude petroleum:					
At refineries	80,407	73,115	70,327	76,971	83,214
Pipeline and tank farm	181,580	172,309	162,476	152,533	168,944
Producers	14,380	14,224	13,592	12,974	12,862
Total crude petroleum	276,367	259,648	246,395	242,478	265,020
Unfinished oils	98,989	100,574	94,761	99,154	106,031
Natural gasoline[1]	6,088	5,163	4,802	6,160	6,480
Plant condensate	958	1,013	1,273	1,675	1,070
Refined products	635,459	677,549	611,748	658,840	695,045
Grand total	1,017,861	1,043,947	958,979	1,008,307	1,073,646

[1] Includes isopentane.

Table 51.—Stocks of crude petroleum in the United States in 1974, by State of origin and month

(Thousand barrels)

State of origin	Jan. 1	Jan. 31	Feb. 28	Mar. 31	Apr. 30	May 31	June 30	July 31	Aug. 31	Sept. 30	Oct. 31	Nov. 30	Dec. 31
Alabama	228	265	260	178	128	181	125	130	148	137	99	152	71
Alaska	3,564	2,280	2,890	2,245	3,376	4,327	4.231	4,593	5,119	4,740	4,854	4,232	4,579
Arizona	78	70	70	79	80	66	97	76	84	82	74	87	77
Arkansas	494	506	576	616	692	957	1,289	900	624	854	936	903	853
California	18,809	17,662	19,434	21,286	22,458	22,993	22,394	23,814	24,393	23,757	22,651	22,606	23,201
Colorado	2,939	2,845	2,918	2,888	3,154	2,955	2,867	2,630	2,738	2,897	2,701	3,040	3,005
Florida	2,245	2,792	2,814	3,058	2,691	2,361	2,493	2,824	2,556	2,580	2,576	2,429	2,188
Illinois	2,918	2,389	2,842	3,191	3,305	3,428	2,850	3,258	3,146	3,609	3,609	3,811	3,585
Indiana	535	481	527	537	548	652	664	633	538	688	566	706	675
Kansas	6,161	6,458	6,616	6,461	6,782	6,549	6,375	5,661	6,141	5,793	6,304	6,247	5,994
Kentucky	470	747	659	548	402	435	293	381	463	413	528	395	398
Louisiana	28,055	29,811	32,261	31,193	30,961	29,321	30,411	29,653	29,831	29,516	30,812	30,844	29,398
Michigan	1,033	694	674	722	714	1,039	1,026	1,041	1,197	1,238	1,232	1,182	1,076
Mississippi	3,331	2,917	2,890	2,939	2,779	3,331	3,246	3,114	3,472	3,031	2,923	2,765	2,591
Missouri	1	--	--	--	--	--	--	--	--	--	--	--	--
Montana	2,889	2,647	2,949	3,014	3,393	3,425	2,835	2,667	2,688	2,839	2,950	2,547	2,709
Nebraska	395	361	475	444	631	598	523	683	477	424	512	646	584
Nevada	--	--	--	--	--	--	--	--	--	--	--	--	--
New Mexico	7,102	6,658	6,418	7,040	6,937	6,920	8,677	8,230	6,812	7,717	7,277	8,831	7,746
New York	30	30	30	30	30	39	30	30	30	30	30	30	30
North Dakota	1,417	1,325	1,415	1,358	1,375	2,194	1,681	1,598	1,419	1,464	1,530	1,534	1,546
Ohio	929	767	891	944	916	953	820	856	946	1,038	922	790	1,007
Oklahoma	12,254	11,907	12,172	14,859	13,389	15,451	15,878	13,753	13,330	12,830	13,537	13,353	12,954
Pennsylvania	578	584	592	702	642	650	642	684	568	510	520	678	466
Texas	92,999	89,715	91,683	90,943	95,456	96,172	95,649	96,288	94,494	93,634	98,654	98,055	94,986
Utah	3,195	3,466	3,475	3,483	3,600	3,515	3,138	3,570	3,476	3,779	3,422	3,449	3,380
West Virginia	581	537	598	631	639	623	593	597	709	589	772	723	697
Wyoming	13,889	14,308	14,615	15,399	16,208	17,740	16,321	17,843	17,129	16,859	17,803	17,347	17,026
Total domestic crude	207,064	202,172	210,744	214,788	221,286	226,825	225,148	225,507	222,523	221,048	227,794	227,382	220,822
Foreign crude:													
Districts I–IV	24,194	22,994	20,831	19,829	26,036	30,576	28,204	30,602	29,283	31,927	29,632	31,802	30,991
District V	11,220	7,869	9,148	10,048	9,063	12,054	15,413	12,577	13,034	13,756	12,011	11,960	13,207
Total foreign crude	35,414	30,863	29,979	29,877	35,099	42,630	43,617	43,179	42,317	45,683	41,643	43,762	44,198
Total crude stocks	242,478	233,035	240,723	244,665	256,385	269,455	268,765	268,686	264,840	266,726	269,437	271,144	265,020
Pennsylvania-grade crude oil (included in "Total domestic crude")	1,767	1,654	1,786	1,994	1,985	1,946	1,768	1,862	1,968	1,879	1,951	1,926	1,777

Table 52.—Stocks of crude petroleum in the United States in 1974, by State and month

(Thousand barrels)

State	Jan. 1	Jan. 31	Feb. 28	Mar. 31	Apr. 30	May 31	June 30	July 31	Aug. 31	Sept. 30	Oct. 31	Nov. 30	Dec. 31
Alabama	906	1,465	990	1,460	917	1,360	1,482	1,332	1,463	1,285	884	1,224	1,353
Alaska	434	466	1,553	707	1,898	1,912	1,988	2,088	2,180	1,737	1,257	1,385	1,354
Arizona	452	454	453	450	449	445	447	455	456	456	450	452	451
Arkansas	1,038	1,048	1,119	1,133	1,210	1,480	1,308	1,437	1,160	1,392	1,470	1,434	1,405
California, Nevada, Oregon, Washington	32,645	27,287	29,418	33,437	32,772	37,796	38,428	39,180	41,037	39,994	38,409	37,721	38,848
Colorado	1,861	1,629	1,703	1,882	2,176	2,045	1,955	1,925	1,661	1,650	1,704	1,664	1,612
Florida, Georgia, South Carolina, Virginia	1,617	1,785	1,876	1,311	1,686	1,569	1,417	1,580	1,270	1,173	905	1,849	1,632
Hawaii	1,463	1,041	1,434	834	1,270	888	1,175	748	699	1,652	903	868	1,238
Illinois	14,734	14,832	16,163	16,532	17,331	17,702	17,159	17,754	17,188	17,358	17,232	18,181	18,032
Indiana	3,361	3,000	3,239	3,398	3,508	3,764	3,415	3,583	3,556	3,343	3,364	3,454	3,215
Iowa and Missouri	6,041	6,023	5,838	6,203	6,631	6,371	6,883	6,516	6,478	5,785	6,675	6,284	6,143
Kansas	9,800	9,908	10,510	10,299	10,498	10,688	10,633	9,914	9,710	9,299	10,093	10,151	9,736
Kentucky and Tennessee	3,946	4,345	4,106	4,688	4,324	4,354	3,986	3,948	4,088	4,165	4,087	4,898	4,878
Louisiana	18,702	18,077	19,190	19,086	19,551	20,208	20,711	21,270	21,022	22,417	20,721	20,908	18,979
Maryland	277	315	318	298	356	351	386	445	441	364	301	178	292
Massachusetts, Delaware, Rhode Island	484	1,416	883	1,234	1,266	1,070	1,169	1,288	1,195	786	1,385	1,029	947
Michigan	2,325	1,865	2,182	2,183	2,085	2,832	2,558	2,901	2,766	2,702	2,600	2,397	2,301
Minnesota and Wisconsin	1,978	2,152	1,785	2,205	2,569	3,793	2,920	2,538	2,193	2,491	2,681	2,622	3,833
Mississippi	4,898	5,708	5,706	5,271	5,133	4,610	4,810	4,364	5,789	4,884	5,182	5,022	4,760
Montana	2,624	2,517	2,778	2,761	3,100	3,123	3,085	2,878	2,694	2,468	2,681	2,744	3,044
Nebraska	1,570	1,527	1,695	1,675	1,755	1,542	1,334	1,590	1,561	1,535	1,676	1,569	1,540
New Jersey	6,527	5,456	6,348	4,226	4,363	5,369	5,494	4,538	5,987	5,154	5,788	5,381	4,322
New Mexico	3,773	3,742	3,784	4,016	4,004	3,873	4,780	4,669	4,582	4,452	4,688	5,082	4,520
New York	385	598	565	526	812	410	320	281	581	632	571	506	722
North Dakota	1,172	1,129	1,217	1,157	1,214	1,934	1,464	1,387	1,202	1,178	1,194	1,171	929
Ohio	5,573	5,022	5,125	5,038	5,114	6,420	6,606	6,591	7,347	7,429	6,977	7,240	7,761
Oklahoma	16,925	16,164	17,618	17,829	18,960	20,930	20,349	19,899	18,804	19,758	21,777	21,744	21,185
Pennsylvania	8,819	8,302	6,884	5,897	8,268	8,392	7,650	8,113	6,566	8,542	7,384	8,367	8,175
Texas	79,388	76,181	75,758	77,806	82,260	82,580	82,944	84,686	81,256	80,813	84,076	84,334	79,398
Utah	1,130	1,508	1,419	1,504	1,826	1,678	1,704	1,560	1,541	1,605	1,708	1,662	1,606
West Virginia	509	502	589	611	580	661	650	656	770	786	848	772	774
Wyoming	7,616	7,626	8,532	9,013	8,499	9,315	9,610	8,627	7,657	9,446	9,826	9,451	9,545
Total	242,478	238,035	240,723	244,665	256,385	269,455	268,765	268,686	264,840	266,726	269,437	271,144	265,020

Table 53.—Stocks of crude petroleum in the United States in 1974, by classification and State and month

(Thousand barrels)

Classification and State	Jan. 1	Jan. 31	Feb. 28	Mar. 31	Apr. 30	May 31	June 30	July 31	Aug. 31	Sept. 30	Oct. 31	Nov. 30	Dec. 31
At refineries:													
Alabama	134	196	221	228	191	254	321	329	370	365	258	210	143
Alaska	109	97	87	78	82	69	167	144	120	125	97	136	90
Arkansas	87	84	118	104	109	101	115	125	110	208	123	112	109
California, Arizona, Nevada, Oregon, Washington	20,099	15,782	16,928	20,201	18,678	23,400	24,417	24,017	24,111	24,139	23,371	22,028	22,970
Colorado	274	300	344	374	352	302	216	248	211	247	261	227	244
Florida, Georgia, South Carolina, Virginia	1,237	1,319	1,506	1,132	1,404	1,199	1,318	1,261	1,039	1,057	684	1,052	1,481
Hawaii	1,468	1,041	1,484	884	1,270	883	1,175	748	699	1,652	903	868	1,233
Illinois	4,087	3,895	4,144	3,997	4,294	4,348	4,759	4,927	4,329	4,279	4,249	4,301	4,506
Indiana	1,299	1,132	1,175	1,137	1,310	1,445	1,275	1,460	1,241	1,202	1,113	1,109	1,128
Kansas	1,600	1,596	1,662	1,825	1,936	1,830	1,715	1,595	1,916	1,714	1,750	1,932	1,301
Kentucky and Tennessee	1,247	626	786	880	898	1,000	879	927	830	1,445	815	1,243	1,039
Louisiana	5,546	5,022	6,140	7,172	7,070	7,341	7,871	7,607	8,134	8,993	7,824	8,154	6,844
Maryland	277	315	318	298	356	351	386	445	441	364	301	178	292
Massachusetts, Delaware, Rhode Island	484	1,416	883	1,234	1,266	1,070	1,169	1,288	1,195	736	1,385	1,029	947
Michigan	868	652	708	768	706	670	580	832	872	996	822	885	721
Minnesota and Wisconsin	1,180	1,099	1,085	1,306	1,327	1,701	1,032	1,094	1,191	841	1,441	1,348	1,784
Mississippi	599	935	912	791	1,098	884	862	545	1,233	1,172	1,077	1,080	1,051
Missouri	311	294	347	298	276	306	325	288	257	299	297	325	300
Montana	682	608	787	692	1,028	919	1,040	959	733	580	782	778	935
Nebraska	16	14	22	36	26	19	21	22	32	31	26	20	20
New Jersey	6,527	5,456	6,348	4,226	4,363	5,369	5,494	4,538	5,987	5,154	5,783	5,331	4,322
New Mexico	207	217	220	280	281	279	705	587	605	664	632	736	541
New York	355	386	366	338	476	871	290	251	375	415	331	335	550
North Dakota	192	142	205	155	228	871	451	348	194	177	176	160	160
Ohio	1,777	1,950	1,685	1,602	1,873	2,225	1,743	1,995	1,917	2,126	1,839	1,978	2,401
Oklahoma	1,303	1,606	1,739	1,489	1,634	1,892	1,982	1,947	1,947	1,396	1,668	1,815	1,704
Pennsylvania	7,354	7,537	6,112	4,814	7,492	7,528	6,891	7,203	5,876	7,900	6,688	7,688	7,487
Texas	16,314	16,354	17,216	18,594	19,212	20,500	18,604	21,298	19,578	19,940	20,163	20,118	16,641
Utah	493	591	649	593	895	750	694	583	638	711	680	711	625
West Virginia	118	119	149	187	155	173	144	172	201	222	268	241	226
Wyoming	727	819	778	1,075	922	1,032	1,003	847	732	938	848	949	919
Total at refineries	76,971	71,600	75,024	76,678	81,198	89,582	87,589	88,625	87,159	90,142	86,655	87,627	88,214

Table 53.—Stocks of crude petroleum in the United States in 1974, by classification and State and month—Continued

(Thousand barrels)

Classification and State	Jan. 1	Jan. 31	Feb. 28	Mar. 31	Apr. 30	May 31	June 30	July 31	Aug. 31	Sept. 30	Oct. 31	Nov. 30	Dec. 31
Pipeline and tank-farm stocks:													
Alabama	716	1,257	756	1,205	712	1,094	1,146	986	1,078	903	616	999	1,199
Alaska	270	315	1,415	585	1,763	1,791	1,768	1,887	2,013	1,564	1,111	1,197	1,709
Arkansas	886	899	936	964	1,036	1,308	1,122	1,241	979	1,113	1,276	1,251	1,225
California, Arizona, Oregon	11,689	10,805	11,637	12,416	13,268	13,605	13,101	14,476	15,935	14,983	14,194	14,892	14,995
Colorado	1,374	1,116	1,146	1,300	1,623	1,542	1,538	1,476	1,249	1,202	1,242	1,236	1,157
Florida	339	353	327	120	235	338	53	230	139	69	231	257	112
Illinois	10,391	10,680	11,762	12,274	12,779	12,598	12,140	12,570	12,593	12,810	12,716	13,058	13,369
Indiana	2,029	1,885	2,081	2,228	2,165	2,286	2,107	2,090	2,282	2,108	2,218	2,812	2,054
Iowa and Missouri	5,729	5,729	5,491	5,905	6,355	6,065	6,558	6,228	6,221	5,486	6,378	5,959	5,843
Kansas	7,970	8,090	8,628	8,255	8,346	8,644	8,695	8,108	7,575	7,366	8,124	8,007	7,725
Kentucky and Tennessee	2,648	3,668	3,319	3,757	3,375	3,302	3,005	2,969	3,200	3,116	3,219	3,602	3,786
Louisiana	10,597	10,569	10,697	9,547	10,142	10,545	10,494	11,317	10,549	10,996	10,491	10,332	9,804
Michigan	1,357	1,113	1,374	1,309	1,285	2,068	1,871	1,978	1,796	1,763	1,680	1,414	1,490
Minnesota and Wisconsin	798	1,053	700	899	1,242	2,092	1,888	1,444	1,002	1,046	1,240	1,274	2,049
Mississippi	4,092	4,534	4,587	4,277	3,832	3,523	3,739	3,608	4,290	3,510	3,897	3,734	3,491
Montana	1,629	1,591	1,667	1,739	1,756	1,860	1,697	1,571	1,645	1,566	1,585	1,649	1,788
Nebraska	1,456	1,415	1,575	1,541	1,631	1,425	1,215	1,462	1,423	1,398	1,544	1,448	1,419
New Mexico	2,716	2,650	2,689	2,862	2,860	2,698	3,198	3,198	3,124	2,909	3,189	3,422	3,095
New York	--	182	169	158	306	9	--	--	176	187	160	141	142
North Dakota	919	980	951	988	927	987	934	963	947	938	960	955	715
Ohio	3,721	2,997	3,365	3,361	3,166	4,120	4,788	4,521	5,355	5,228	5,063	5,187	5.285
Oklahoma	14,746	13,690	15,011	15,458	16,451	18,156	17,528	17,063	15,968	17,473	19,216	19,036	18,562
Pennsylvania	819	627	584	938	648	722	617	768	542	494	498	531	540
Texas	58,476	55,221	53,962	54,445	58,441	57,467	59,654	58,744	57,051	56,086	59,160	59,420	58,036
Utah	517	778	633	769	785	778	854	809	768	738	857	798	828
West Virginia	226	218	275	309	260	323	341	319	404	399	410	366	388
Wyoming	6,423	6,346	7,293	7,468	7,100	7,798	8,122	7,295	6,447	8,035	8,500	8,024	8,148
Total	152,538	148,661	152,980	155,027	162,489	167,144	168,173	167,311	164,746	168,481	169,775	170,496	168,944
Lease stocks	12,974	12,774	12,719	12,960	12,698	12,729	13.003	12,750	12,935	13,103	13,007	13,021	12,862
Total stocks:													
1974	242,478	233,035	240,723	244,665	256,385	269,455	268,765	268,686	264,840	266,726	269,437	271,144	265,020
1973	246,395	237,469	235,362	244,181	248,783	257,867	248,857	243,678	248,314	241,276	246,297	249,998	242,478

Table 54.—Stocks of refined petroleum products (including unfinished oils) in the United States at end of month

(Thousand barrels)

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
1973												
Gasoline:												
Motor	221,954	216,484	207,732	204,877	202,201	208,466	211,572	205,189	210,359	214,610	207,418	209,478
Aviation	4,024	3,551	3,349	3,309	3,109	3,089	3,437	3,417	3,529	3,598	3,982	3,939
Total gasoline	225,978	220,035	211,081	208,186	205,310	211,555	215,009	208,606	213,888	218,208	211,400	213,417
Jet fuel:												
Naphtha-type	5,953	5,486	5,899	5,209	5,055	4,603	4,280	4,268	4,652	4,242	4,939	5,599
Kerosine-type	18,861	19,951	21,686	22,672	20,770	20,844	21,381	20,583	20,497	21,335	23,600	22,945
Total jet fuel	24,814	25,437	27,585	27,881	25,825	25,447	25,661	24,851	25,149	25,577	28,539	28,544
Ethane (including ethylene)	7,139	7,126	7,173	6,869	6,976	6,733	6,734	6,374	6,198	6,139	5,381	5,023
Liquefied gases [1]	62,083	52,756	56,584	63,572	73,062	83,315	94,296	100,476	105,067	105,116	98,384	93,618
Kerosine	16,038	14,612	16,404	18,088	19,148	20,160	20,477	21,590	22,105	23,549	21,203	21,022
Distillate fuel oil	130,993	113,310	111,299	114,723	119,131	137,869	160,901	177,304	190,209	203,000	200,218	196,461
Residual fuel oil	49,154	43,058	44,711	47,044	49,207	51,811	53,363	53,586	55,091	54,964	51,935	53,480
Petrochemical feedstocks	2,618	2,848	3,057	3,029	2,737	2,859	2,638	2,360	2,256	2,620	2,442	2,387
Special naphthas	5,038	4,576	4,491	4,860	4,316	4,242	4,520	4,328	4,450	4,337	4,383	4,521
Lubricants	13,397	13,341	13,279	13,441	12,910	12,770	12,209	11,765	11,805	11,623	12,057	12,186
Wax	1,058	989	947	1,006	917	920	941	922	874	913	926	990
Coke	8,599	8,976	9,739	9,475	9,609	9,824	10,287	10,435	10,136	9,783	10,087	9,974
Asphalt	24,845	26,995	29,775	31,002	30,247	27,330	22,870	16,756	14,900	12,469	12,055	15,024
Road oil	1,896	1,496	1,781	2,094	2,014	1,814	1,535	1,112	1,035	866	723	799
Miscellaneous	1,636	1,700	1,523	1,621	1,701	1,526	1,707	1,758	1,833	1,716	1,852	1,394
Unfinished oils	87,767	87,583	97,646	104,956	105,404	103,615	102,307	98,925	101,904	102,499	103,586	99,154
Total 1973	662,053	624,838	637,075	657,847	668,514	701,790	735,455	741,148	766,900	783,379	765,171	757,994
1974												
Gasoline:												
Motor	217,542	219,105	220,347	223,805	218,711	217,421	218,889	219,004	227,070	220,797	218,444	218,410
Aviation	3,785	3,885	3,234	3,024	3,168	3,094	3,273	3,057	3,646	3,347	3,457	3,471
Total gasoline	221,327	222,990	223,581	226,829	221,879	220,515	222,162	222,061	230,716	224,144	221,901	221,881
Jet fuel:												
Naphtha-type	5,828	6,069	6,711	6,837	6,701	6,677	6,436	5,742	5,779	5,606	5,883	5,529
Kerosine-type	23,904	23,548	23,285	24,888	25,623	25,523	25,235	25,247	24,407	24,958	23,733	23,906
Total jet fuel	29,732	29,617	29,996	31,725	32,324	32,200	31,671	30,989	30,186	30,564	29,616	29,435
Ethane (including ethylene)	4,747	4,451	4,533	4,644	5,185	5,424	5,423	5,319	5,088	4,945	4,560	4,562
Liquefied gases [1]	85,332	84,049	88,372	94,803	104,168	111,204	118,982	125,392	126,169	123,987	117,831	107,980
Kerosine	17,486	15,609	15,001	14,873	16,579	17,315	17,195	17,086	17,079	16,999	16,707	15,269
Distillate fuel oil	181,217	149,162	128,852	125,587	141,843	160,680	182,495	198,710	208,308	209,945	212,913	200,068
Residual fuel oil	46,548	45,004	47,222	51,339	54,356	57,891	59,787	60,988	60,251	58,679	60,363	59,694
Petrochemical feedstocks	2,206	2,662	2,733	2,666	2,912	3,177	3,195	3,104	2,980	3,082	3,298	3,486
Special naphthas	4,556	4,462	4,595	4,627	4,872	4,901	4,944	4,959	5,001	5,033	5,393	5,720
Lubricants	12,016	12,343	12,729	12,957	12,744	13,956	13,796	14,422	14,698	14,861	15,414	16,060
Wax	909	922	868	904	945	1,006	997	1,077	1,114	1,139	1,147	1,195
Coke	9,642	9,057	8,266	7,756	7,455	6,898	6,572	6,354	6,532	6,472	6,217	5,420
Asphalt	17,961	20,145	23,153	25,443	25,778	24,540	22,702	20,238	17,278	15,407	17,005	21,370
Road oil	918	1,115	1,502	1,751	1,979	1,866	1,738	1,645	1,398	1,008	879	1,080
Miscellaneous	1,533	1,633	1,854	2,370	2,271	2,015	1,542	1,604	1,682	1,579	1,719	1,825
Unfinished oils	97,862	95,077	106,861	109,501	116,748	118,720	116,727	113,223	109,554	110,002	109,136	106,031
Total 1974	733,992	698,298	700,118	717,775	752,038	782,308	809,928	827,171	838,034	827,846	824,099	801,076

[1] Includes liquefied refinery gas used for petrochemical feedstocks.

Table 55.—Value of crude petroleum at wells in the United States, by State

State	1973		1974	
	Total value at wells (thousands)	Average value per barrel	Total value at wells (thousands)	Average value per barrel
Alabama	$41,772	$3.58	$113,808	$8.54
Alaska	261,877	3.62	347,408	4.92
Arizona	3,103	3.86	3,885	5.25
Arkansas	70,618	3.92	122,817	7.43
California	1,045,193	3.11	1,710,350	5.30
Colorado	155,507	4.25	283,904	7.57
Florida	150,070	4.59	351,331	9.66
Illinois	132,490	4.32	244,395	8.87
Indiana	20,823	3.92	42,402	8.62
Kansas	281,465	4.25	490,984	7.96
Kentucky	34,515	3.97	68,340	8.72
Louisiana:				
Gulf coast	3,170,847	4.00	4,551,481	6.52
Northern	156,855	3.94	260,291	6.70
Total or average Louisiana	3,327,702	4.00	4,811,772	6.53
Michigan	59,413	4.07	154,746	8.59
Mississippi	213,747	3.81	309,758	6.10
Montana	115,428	3.33	229,802	6.65
Nebraska	28,035	3.87	45,167	6.83
New Mexico:				
Southeastern	383,740	4.11	656,898	7.24
Northwestern	30,801	4.00	55,680	6.96
Total or average New Mexico	414,041	4.10	712,578	7.22
New York	5,412	5.60	9,538	10.65
North Dakota	78,916	3.90	119,022	6.04
Ohio	44,690	5.08	89,348	9.88
Oklahoma	723,273	3.78	1,277,076	7.18
Pennsylvania	18,440	5.62	36,220	10.41
South Dakota	988	3.59	3,283	6.65
Texas:				
Gulf coast	1,041,037	4.11	1,826,100	7.41
East Texas field	800,775	3.98	508,302	7.04
West Texas	2,639,280	3.95	4,507,693	6.76
Panhandle	87,859	3.94	149,156	7.00
Rest of State	1,088,672	3.94	1,781,752	7.00
Total or average Texas	5,157,623	3.98	8,773,003	6.95
Utah	117,743	3.61	279,858	7.11
West Virginia	11,965	5.02	27,058	10.15
Wyoming	541,820	3.82	914,360	6.53
Other States[1]	1,241	3.48	3,341	8.72
Total or average United States	13,057,905	3.89	21,580,549	6.74

[1] Missouri, Nevada, Tennessee, and Virginia.

Table 56.—Posted price per barrel of petroleum at wells in the United States in 1974, by grade[1]

Grade	Price per barrel
Pennsylvania grade:	
Bradford and Allegheny districts	$6.88
Southwest Pennsylvania	6.12
Corning grade	5.17
Western Kentucky	5.20
Indiana-Illinois	5.20
Coldwater, Michigan	5.00
Oklahoma-Kansas:	
34°-34.9° API	5.11
36°-36.9° API	5.15
Texas, Panhandle (Carson, Gray, Hutchinson, Wheeler Counties), 35°-35.9° API	5.10
West Texas, 30°-30.9° API (sweet)	5.11
Lea County, New Mexico, 30°-30.9° API (sour)	5.00
South Texas, Mirando, 24°-24.9° API	5.30
East Texas	5.20
Conroe, Texas	5.30
Texas:	
30°-30.9° API	5.05
20°-20.9° API	4.95
Louisiana, 30°-30.9° API	5.15
Caddo-Pine Island, Louisiana, 36°-36.9° API	5.04
Magnolia Smackover Limestone, Arkansas, 31°-31.9° API	4.84
Elk Basin, Wyoming (including Montana), 30°-30.9° API	4.86
California:	
Coalinga, 32°-32.9° API	5.01
Kettlemen Hills, 37°-37.9° API	5.26
Midway Sunset, 19°-19.9° API	4.28
Wilmington, 24°-24.9° API	4.68

[1] No price changes listed in 1974.

Source: Platt's Oil Price Handbook.

Table 57.—Wholesale price index for crude petroleum

(1967=100)

Month	1970	1971	1972	1973	1974
January	106.0	113.2	113.2	114.7	178.4
February	106.0	113.2	113.2	114.7	201.7
March	106.0	113.2	113.2	114.9	201.7
April	106.0	113.2	113.2	117.1	201.7
May	106.0	113.2	113.2	122.0	201.7
June	106.0	113.2	113.2	125.3	201.7
July	104.8	113.2	113.2	125.3	224.4
August	104.8	113.2	114.7	125.3	225.2
September	104.8	113.2	114.7	133.3	225.4
October	104.8	113.2	114.7	133.3	226.2
November	104.8	113.2	114.7	139.3	231.0
December	113.2	113.2	114.7	146.2	223.0
Average	106.1	113.2	113.8	126.0	211.8

Source: Bureau of Labor Statistics, U.S. Department of Labor.

Table 58.—Average monthly price of petroleum products in the United States, 1973–74

Product	Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Average for year
Gasoline 92 octane, cents per gallon:														
At refineries in Oklahoma	1973	12.96	13.18	13.38	13.71	13.88	14.75	14.75	14.75	15.25	16.50	18.34	20.43	15.16
	1974	25.24	26.96	29.59	30.50	30.50	30.50	30.15	29.03	28.42	27.33	27.38	27.50	28.59
Tank-wagon prices to dealers at 55 cities on first of month	1973	18.46	18.09	18.75	19.02	19.21	19.22	19.22	19.11	19.13	20.17	20.90	22.53	19.48
	1974	25.06	28.20	28.08	29.70	31.36	32.89	32.42	33.07	32.85	30.54	30.80	31.45	30.54
At service station (including all taxes)	1973	37.16	36.74	37.87	38.25	38.42	38.71	38.76	38.78	38.71	39.66	40.53	42.26	38.82
	1974	44.82	48.04	50.08	51.61	53.71	55.55	55.59	55.71	55.04	52.91	52.66	53.15	52.41
Kerosine, cents per gallon:														
No. 1 range at Chicago district	1973	12.27	12.98	13.49	14.60	15.13	15.53	15.00	15.01	16.88	17.88	20.16	22.77	15.98
	1974	27.76	29.60	30.10	30.13	30.50	31.43	31.56	30.24	30.00	30.00	30.00	30.00	30.11
No. 1 fuel oil at Oklahoma	1973	10.53	11.34	11.38	11.78	12.38	12.69	12.75	12.75	13.19	14.19	15.49	18.40	13.07
	1974	23.70	23.94	24.70	26.07	26.13	26.93	28.38	27.39	27.25	27.25	27.25	27.25	26.35
Kerosine (or No. 1 fuel oil) at New York Harbor	1973	13.09	13.75	13.75	13.75	13.75	13.75	13.75	13.75	13.75	14.65	16.28	17.30	14.27
	1974	26.03	26.30	26.30	26.50	29.93	30.88	30.88	30.88	31.14	31.66	30.23	29.00	29.14
Kerosine (or No. 1 fuel oil) at Tampa	1973	12.69	13.25	13.25	13.25	13.25	13.25	13.25	13.25	13.25	13.25	15.82	17.29	13.75
	1974	17.40	23.60	23.60	23.60	27.27	28.38	28.89	28.98	28.08	28.36	27.74	27.55	26.12
Distillate and diesel fuel oil, cents per gallon:														
No. 2 fuel oil at refineries, Oklahoma	1973	9.95	10.48	10.50	10.90	11.50	11.81	11.88	11.88	12.31	13.31	14.50	17.40	12.20
	1974	22.89	22.94	23.70	25.07	25.13	25.93	27.38	26.39	26.25	26.25	26.25	26.25	25.87
No. 2 fuel oil at New York Harbor	1973	12.09	12.75	12.75	13.00	13.38	14.07	14.28	14.38	15.13	16.93	18.62	22.70	15.01
	1974	26.34	24.95	24.65	24.50	27.60	27.78	28.10	28.10	28.31	28.95	28.25	27.54	27.09
Marine diesel, dollars per barrel:														
New York Harbor[1]	1974	16.36	16.36	16.36	16.18	15.45	15.45	15.45	15.45	15.91	15.45	15.00	15.00	15.70
New Orleans	1973	5.04	5.04	5.04	5.34	5.67	5.76	6.26	6.47	6.90	7.47	10.16	10.88	6.67
	1974	16.36	16.36	16.36	16.18	15.45	15.45	15.45	15.45	15.45	15.28	15.12	15.12	15.67
San Francisco	1973	6.27	6.27	6.27	6.27	6.27	6.27	7.28	7.61	7.68	8.12	9.73	10.13	7.35
	1974	15.68	15.68	15.68	15.68	15.68	15.68	15.68	15.68	15.68	15.68	15.68	15.68	15.68
Residual fuel oil, dollars per barrel:														
No. 6 fuel oil at refineries, Oklahoma	1973	2.60	2.60	2.60	2.72	2.73	2.73	2.73	2.73	2.73	3.13	3.34	4.28	2.91
	1974	4.38	4.38	5.62	8.62	8.85	8.85	8.85	8.85	8.85	8.85	8.85	8.85	7.82
No. 6 fuel oil at New York Harbor (maximum 0.3% sulfur)	1973	5.04	5.04	5.17	5.40	5.39	5.42	5.54	5.63	5.87	6.21	8.22	9.02	5.99
	1974	13.10	15.32	15.32	15.32	14.64	13.44	13.55	13.60	13.60	13.79	13.86	13.77	14.11
Bunker "C" for ships, dollars per barrel:														
New York	1973	3.48	3.48	3.48	3.55	3.60	3.60	3.60	3.60	3.60	4.58	5.23	5.42	3.93
	1974	8.00	10.91	10.99	10.99	10.77	10.63	10.69	10.69	10.69	10.99	11.09	11.09	10.63
New Orleans	1973	3.48	3.48	3.48	3.55	3.60	3.60	3.60	3.60	3.60	4.52	5.73	6.10	4.03
	1974	8.57	11.07	10.99	10.89	10.68	10.69	10.71	10.64	10.50	10.50	10.50	10.50	10.52
San Francisco	1973	3.69	3.69	3.69	3.80	3.87	3.87	4.27	4.60	5.06	5.40	6.72	7.21	4.65
	1974	11.74	11.88	10.98	11.38	11.47	11.47	11.47	11.40	11.37	10.77	10.05	10.05	11.17

Lubricating oil, cents per gallon:														
East coast:														
200 viscosity at 100, 0–10 pour test, 95 V.I.	1973	27.25	27.25	27.25	27.25	27.25	27.25	27.25	27.94	28.50	31.00	31.73	33.00	28.58
	1974	33.47	39.50	42.85	43.50	52.25	52.25	52.25	54.25	54.25	54.25	54.25	54.25	48.94
500 viscosity at 100, 0–10 pour test, 95 V.I.	1973	25.75	25.75	25.75	25.75	25.75	25.75	26.25	26.31	26.50	29.00	29.73	31.00	26.94
	1974	35.97	42.00	45.35	46.00	55.50	55.62	56.00	58.00	58.00	58.00	58.00	58.00	52.20
South Texas: 500 viscosity, No. 2½–3½ color	1973	19.75	19.75	19.75	19.75	19.75	19.75	19.75	20.52	22.52	24.06	25.00	25.00	21.28
	1974	29.52	35.00	38.68	39.50	39.50	40.63	41.50	41.50	41.50	41.50	41.50	41.50	39.32
Liquid petroleum gas (propane), cents per gallon:														
New York Harbor	1973	9.18	9.18	9.18	9.36	9.48	10.42	10.89	10.89	12.14	11.69	12.37	13.38	10.68
	1974	17.75	20.81	18.24	18.24	18.24	19.57	20.88	20.35	15.74	15.80	17.74	17.74	18.43
Oklahoma	1973	5.67	5.90	6.46	6.93	8.30	9.28	9.50	9.50	11.40	13.83	13.83	13.86	9.54
	1974	16.36	16.34	13.71	13.59	13.59	16.55	18.54	16.94	13.29	13.00	13.00	13.50	14.87
Baton Rouge	1973	6.21	6.40	6.91	7.26	8.49	9.16	9.25	9.25	10.07	11.50	11.85	13.28	9.13
	1974	16.57	16.12	13.50	13.48	13.48	16.67	19.28	19.02	15.64	15.67	16.64	16.64	16.06

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[1] 1973 not listed.

Source: Platt's Oil Price Handbook and Oilmanac.

Table 59.—Petroleum oils, crude and refined, exported from the United States, including shipments to territories and possessions, by month[1]

(Thousand barrels)

Year and class	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
1973													
Crude petroleum	--	--	--	--	128	--	232	--	160	--	--	177	697
Refined products:													
Gasoline:[2]													
Motor	32	142	22	130	151	28	70	8	27	251	459	146	1,466
Aviation	7	12	67	4	6	6	12	49	8	10	8	9	198
Total gasoline	39	154	89	134	157	34	82	57	35	261	467	155	1,664
Jet fuel:													
Naphtha-type	180	184	169	54	22	11	3	--	--	1	11	5	640
Kerosine-type	34	21	29	172	112	128	105	32	58	100	92	45	928
Total jet fuel	214	205	198	226	134	139	108	32	58	101	103	50	1,568
Liquefied gases:													
Butane	385	411	490	336	318	330	396	386	366	359	344	334	4,455
Propane	507	728	619	461	459	375	392	434	400	399	339	387	5,500
Total liquefied gases	892	1,139	1,109	797	777	705	788	820	766	758	683	721	9,955
Kerosine	9	8	7	--	8	--	4	8	7	7	24	3	85
Distillate fuel oil	332	67	72	197	54	253	105	264	761	721	97	308	3,231
Residual fuel oil	970	888	741	1,172	1,091	183	1,046	852	593	585	145	241	8,507
Petrochemical feedstocks	235	721	270	338	476	675	662	675	451	839	716	781	6,839
Special naphthas	169	108	134	111	137	140	160	125	119	111	149	189	1,652
Lubricants	1,208	1,069	1,243	1,168	1,190	1,190	1,044	976	961	767	869	1,062	12,747
Wax	121	60	88	85	87	73	82	51	108	49	91	70	965
Coke	2,257	2,794	2,848	3,928	3,000	2,955	3,005	2,755	3,142	2,552	2,588	3,152	34,976
Asphalt	18	16	23	34	29	27	26	34	31	43	29	30	340
Miscellaneous	65	78	128	77	91	89	119	114	98	89	116	123	1,187
Total refined	6,529	7,307	6,950	8,267	7,231	6,463	7,231	6,763	7,130	6,883	6,077	6,885	83,716
Total crude and refined	6,529	7,307	6,950	8,267	7,359	6,463	7,463	6,763	7,290	6,883	6,077	7,062	84,413
1974 p													
Crude petroleum	534	281	--	15	200	44	--	--	--	--	--	--	1,074
Refined products:													
Gasoline:[2]													
Motor	126	18	225	41	10	11	21	172	15	17	13	196	865
Aviation	9	3	6	9	8	7	15	65	4	5	8	9	148
Total gasoline	135	21	231	50	18	18	36	237	19	22	21	205	1,013

Jet fuel:													
Naphtha-type	4	7	5	4	4	5	3	5	3	4	5	31	80
Kerosine-type	62	53	74	63	22	93	157	60	37	155	67	46	889
Total jet fuel	66	60	79	67	26	98	160	65	40	159	72	77	969
Liquefied gases:													
Butane	376	276	325	326	346	328	375	322	339	364	334	356	4,067
Propane	464	328	400	357	364	373	469	431	477	433	410	465	4,971
Total liquefied gases	840	604	725	683	710	701	844	753	816	797	744	821	9,038
Kerosine	3	--	3	5	7	2	4	2	3	4	--	3	36
Distillate fuel oil	125	108	204	41	27	34	84	17	41	15	55	104	855
Residual fuel oil	292	317	286	469	357	435	215	932	451	508	241	466	4,969
Petrochemical feedstocks	287	512	535	843	286	548	769	446	496	359	181	299	5,561
Special naphthas	127	131	99	117	135	139	85	118	72	131	81	65	1,300
Lubricants	1,023	676	1,021	1,206	1,184	1,020	1,279	1,010	799	918	988	812	11,936
Wax	54	62	114	75	63	72	78	91	36	55	61	118	879
Coke	2,806	2,837	2,597	3,524	4,436	3,891	4,147	3,873	2,252	3,787	3,012	4,082	41,244
Asphalt	20	14	57	69	72	31	51	26	14	12	23	21	410
Miscellaneous	96	57	113	136	122	119	97	94	87	80	115	91	1,207
Total refined	5,874	5,399	6,054	7,285	7,443	7,108	7,849	7,664	5,126	6,847	5,594	7,164	79,417
Total crude and refined	6,408	5,680	6,064	7,300	7,648	7,152	7,849	7,664	5,126	6,847	5,594	7,164	80,491

[p] Preliminary.

[1] Compiled from records of U.S. Department of Commerce.

[2] Includes benzol, natural gasoline, and antiknock compounds.

Table 60.—Crude oil and petroleum products exported from the United States, by country of destination

(Thousand barrels)

Country of destination	Crude oil	Gasoline	Special naphthas	Jet fuel	Kerosine	Distillate fuel oil	Residual fuel oil	Lubricating oil	Asphalt	Liquefied petroleum gases	Wax	Coke	Petrochemical feedstocks	Miscellaneous products	Total
1973															
North America:															
Canada	--	32	255	642	4	22	3,355	1,549	67	363	116	4,141	699	182	11,427
Mexico	--	932	89	171	(1)	801	2,356	184	207	9,128	75	1,990	30	21	15,984
Total	--	964	344	813	4	823	5,711	1,733	274	9,491	191	6,131	729	203	27,411
Central America and Caribbean:															
Bahamas	--	6	3	1	--	6	67	38	--	2	(1)	--	1	1	125
British West Indies	--	--	(1)	--	--	--	--	2	1	--	(1)	--	1	(1)	4
Jamaica	--	--	2	--	--	(1)	--	183	3	(1)	1	--	1	3	193
Netherlands Antilles	--	(1)	2	(1)	--	196	837	32	1	--	(1)	32	(1)	1	1,101
Panama	--	--	13	--	--	50	486	58	1	--	4	31	3	2	648
Puerto Rico	--	52	87	--	(1)	1	122	316	1	33	23	306	20	21	985
Trinidad	--	--	10	--	--	--	1	34	2	--	(1)	--	1	1	49
Virgin Islands	--	76	1	--	2	3	(1)	25	1	2	(1)	1	1	(1)	112
Others	--	2	55	--	5	--	--	255	10	12	33	--	9	16	397
Total	--	136	173	1	7	256	1,513	943	23	49	61	370	37	45	3,614
South America:															
Argentina	--	165	9	--	(1)	--	--	39	(1)	(1)	2	--	17	2	234
Brazil	--	122	123	--	(1)	--	59	1,943	2	--	8	316	226	158	2,957
Chile	--	(1)	2	--	--	(1)	2	262	--	--	4	--	(1)	8	278
Ecuador	--	--	3	--	(1)	--	--	25	1	(1)	(1)	--	3	6	38
Peru	--	--	2	--	1	--	163	91	(1)	(1)	4	--	2	5	268
Venezuela	--	(1)	33	--	2	184	1	47	4	(1)	7	79	1	30	388
Others	--	(1)	4	--	(1)	--	2	102	1	1	3	--	5	13	131
Total	--	287	176	--	3	184	227	2,509	8	1	28	395	254	222	4,294
Europe:															
Belgium	177	1	4	--	--	(1)	--	896	2	1	4	4,480	17	8	5,590
Denmark	--	--	1	--	--	154	162	60	(1)	(1)	4	1	1	2	385
France	--	3	44	--	(1)	--	(1)	77	1	(1)	34	1,060	674	16	1,909
Greece	--	--	1	(1)	--	--	--	19	(1)	--	(1)	256	1	2	279
Ireland	--	--	(1)	--	--	--	--	9	(1)	--	1	--	(1)	(1)	10
Italy	--	2	40	--	4	--	143	386	1	(1)	38	1,413	1,274	52	3,353
Netherlands	--	10	305	--	2	353	1	231	1	(1)	12	2,797	857	94	4,663
Norway	--	(1)	(1)	--	--	--	--	15	1	--	(1)	994	1	2	1,013
Spain	--	(1)	20	--	--	1	--	59	(1)	1	6	567	625	13	1,292
Sweden	--	(1)	(1)	--	(1)	--	--	102	(1)	--	4	591	113	4	814
United Kingdom	--	5	176	--	--	625	131	756	1	2	19	441	1,070	23	3,249
West Germany	--	4	36	--	28	2	--	301	2	1	414	4,623	9	30	5,450
Yugoslavia	--	(1)	(1)	--	--	--	(1)	5	--	--	--	187	1	(1)	193
Others	--	2	2	--	--	--	--	62	2	--	3	7	6	5	89
Total	177	27	629	(1)	34	1,135	437	2,978	11	5	539	17,417	4,649	251	28,289

Middle East:														
Bahrain	--	(1)	(1)	--	--	--	--	3	(1)	1	(1)	254	(1)	1	259
Iran	--	2	2	--	1	--	(1)	46	(1)	--	1	112	2	6	172
Israel	--	--	1	--	--	--	1	57	(1)	3	2	--	4	3	71
Saudi Arabia	--	(1)	1	--	--	1	--	123	1	1	(1)	--	2	1	130
Turkey	--	(1)	1	--	--	--	21	134	--	--	(1)	--	81	15	252
Others	--	1	2	--	--	--	2	61	3	--	(1)	--	3	1	73
Total	--	3	7	--	1	1	24	424	4	5	3	866	92	27	957
Africa:														
Egypt	--	(1)	(1)	--	--	--	--	105	--	--	--	--	1	(1)	106
Ghana	--	(1)	2	--	--	--	--	51	1	--	(1)	291	4	3	352
Nigeria	--	1	1	--	1	--	1	40	--	--	1	(1)	1	10	56
South Africa, Republic of	--	2	49	--	2	1	101	215	6	1	29	42	382	38	868
Tunisia	--	--	(1)	--	(1)	--	--	99	(1)	--	--	--	--	--	99
Others	--	1	3	--	1	--	--	136	5	--	4	--	8	19	177
Total	--	4	55	--	4	1	102	646	12	1	34	333	396	70	1,658
Asia and Oceania:														
Australia	--	2	59	--	8	--	1	188	1	(1)	10	379	607	50	1,305
French Pacific Islands	--	110	--	10	13	49	20	9	(1)	--	--	--	(1)	--	211
India	--	(1)	5	--	--	--	--	463	1	(1)	4	--	1	(1)	474
Indonesia	--	(1)	1	--	1	--	--	65	1	(1)	(1)	--	13	4	85
Japan	520	1	115	--	8	81	393	1,306	3	401	57	9,197	41	179	12,302
Malaysia	--	(1)	27	--	--	--	(1)	160	(1)	--	--	110	1	2	300
New Zealand	--	(1)	5	--	--	--	--	20	(1)	1	3	239	2	37	307
Philippines	--	(1)	19	--	(1)	--	--	367	(1)	--	7	1	7	20	421
South Vietnam	--	--	(1)	--	--	--	(1)	381	(1)	--	6	--	(1)	3	390
Taiwan	--	--	1	--	--	1	(1)	69	(1)	--	5	27	5	34	142
Thailand	--	(1)	7	--	-	--	--	257	(1)	(1)	2	--	1	10	277
U.S. Pacific Islands [2]	--	128	--	744	2	700	1	12	--	--	--	--	--	--	1,587
Others	--	2	29	--	--	--	78	217	2	1	15	11	4	30	389
Total	520	243	268	754	32	831	493	3,514	8	403	109	9,964	682	369	18,190
Total 1973 exports	697	1,664	1,652	1,568	85	3,231	8,507	12,747	340	9,955	965	34,976	6,839	1,187	84,413

See footnotes at end of table.

Table 60.—Crude oil and petroleum products exported from the United States, by country of destination—Continued

(Thousand barrels)

Country of destination	Crude oil	Gasoline	Special naphthas	Jet fuel	Kerosine	Distillate fuel oil	Residual fuel oil	Lubricating oil	Asphalt	Liquefied petroleum gases	Wax	Coke	Petrochemical feedstocks	Miscellaneous products	Total
1974 p															
North America:															
Canada	108	27	326	516	4	114	2,674	1,446	68	99	87	5,185	759	199	11,612
Mexico	--	536	105	138	1	168	1,558	163	173	8,887	112	962	51	31	12,885
Total	108	563	431	654	5	282	4,232	1,609	241	8,986	199	6,147	810	230	24,497
Central America and Caribbean:															
Bahamas	966	7	8	2	(1)	12	11	30	1	1	(1)	--	(1)	(1)	1,038
British West Indies	--	--	(1)	--	--	--	(1)	2	1	(1)	(1)	--	(1)	(1)	3
Jamaica	--	--	2	--	--	1	(1)	165	2	1	1	(1)	1	1	174
Netherlands Antilles	--	--	1	--	--	--	(1)	19	(1)	(1)	(1)	--	(1)	(1)	20
Panama	--	(1)	1	--	--	--	--	51	1	--	3	24	2	--	82
Puerto Rico	--	171	34	--	2	175	51	596	5	5	20	451	2	8	1,520
Trinidad	--	10	--	--	--	--	(1)	43	1	--	1	--	(1)	1	56
Virgin Islands	--	56	1	--	2	(1)	519	43	20	(1)	(1)	--	(1)	(1)	641
Others	--	3	39	2	(1)	11	4	266	10	27	48	1	18	26	455
Total	966	247	86	4	4	199	585	1,215	41	34	73	476	23	36	3,989
South America:															
Argentina	--	(1)	8	--	(1)	--	(1)	27	1	--	4	--	1	3	44
Brazil	--	(1)	148	--	--	--	44	1,902	2	3	35	436	462	169	3,201
Chile	--	1	1	--	--	--	7	214	--	--	6	--	1	11	241
Ecuador	--	--	1	--	--	--	--	26	1	--	2	--	3	5	38
Peru	--	1	4	--	3	(1)	30	79	(1)	--	7	--	9	5	136
Venezuela	--	(1)	25	--	3	(1)	10	33	10	2	6	111	3	39	242
Others	--	--	2	(1)	(1)	--	--	77	1	--	3	(1)	6	14	103
Total	--	2	189	(1)	4	(1)	91	2,358	15	5	63	547	485	246	4,005
Europe:															
Belgium	--	--	11	--	--	2	(1)	750	2	1	3	3,801	9	12	4,591
Denmark	--	--	1	--	--	--	--	9	2	1	3	123	1	1	141
France	--	1	18	(1)	(1)	(1)	(1)	188	2	--	28	735	501	6	1,429
Greece	--	--	(1)	--	--	2	--	10	1	(1)	(1)	164	1	1	179
Ireland	--	(1)	(1)	--	--	--	--	8	(1)	--	2	--	(1)	(1)	10
Italy	--	(1)	7	--	(1)	--	1	356	1	--	25	2,193	697	47	3,327
Netherlands	--	(1)	204	--	--	--	7	567	(1)	1	13	4,680	632	41	6,145
Norway	--	(1)	1	--	--	--	--	21	2	(1)	(1)	1,160	1	3	1,188
Spain	--	(1)	1	--	--	--	--	38	(1)	--	12	1,018	305	21	1,395
Sweden	--	(1)	1	--	--	--	--	99	(1)	--	4	417	63	6	590
United Kingdom	--	1	35	--	--	(1)	1	788	3	2	20	511	929	27	2,317
West Germany	--	(1)	27	--	--	(1)	(1)	252	1	1	277	4,287	26	18	4,889
Yugoslavia	--	--	(1)	--	--	--	--	3	--	1	--	189	(1)	(1)	193
Others	--	53	12	--	1	(1)	1	73	(1)	(1)	3	1	11	6	161
Total	--	55	318	(1)	1	4	10	3,112	14	7	390	19,279	3,176	189	26,555

Middle East:														
Bahrain	--	(1)	(1)	--	--	--	--	3	(1)	2	(1)	299	(1)	1	305
Iran	--	2	(1)	--	--	--	--	126	2	(1)	(1)	109	2	14	255
Israel	--	(1)	1	--	--	--	1	26	(1)	(1)	1	--	11	4	44
Saudi Arabia	--	(1)	2	--	(1)	--	1	176	2	--	1	--	13	6	201
Turkey	--	(1)	1	--	--	--	--	82	1	--	(1)	--	116	17	217
Others	--	(1)	4	--	--	--	1	56	24	(1)	1	31	6	1	124
Total	--	2	8	--	--	--	3	469	29	2	3	439	148	43	1,146
Africa:														
Egypt	--	--	(1)	--	--	--	--	80	--	--	(1)	--	(1)	(1)	80
Ghana	--	--	1	--	--	--	--	56	1	--	(1)	380	2	3	443
Nigeria	--	--	2	--	--	--	--	49	8	--	3	--	2	11	75
South Africa, Republic of	--	(1)	59	--	1	--	--	193	7	(1)	39	--	464	69	832
Tunisia	--	--	--	--	--	--	--	22	--	--	--	117	--	--	139
Others	--	1	2	--	--	(1)	--	144	16	--	6	(1)	7	17	193
Total	--	1	64	--	1	(1)	--	544	32	(1)	48	497	475	100	1,762
Asia and Oceania:														
Australia	--	2	42	--	5	--	2	239	3	1	15	788	364	59	1,520
French Pacific Islands	--	72	1	--	11	--	--	12	1	1	(1)	--	(1)	--	98
India	--	--	1	--	--	--	--	256	(1)	--	3	8	(1)	1	269
Indonesia	--	(1)	(1)	--	(1)	2	1	129	3	--	1	--	18	4	158
Japan	--	(1)	84	--	4	--	43	1,086	7	1	50	12,344	29	161	13,809
Malaysia	--	--	11	--	--	--	--	69	(1)	--	(1)	67	1	2	150
New Zealand	--	(1)	9	--	(1)	--	(1)	30	(1)	(1)	3	295	5	36	378
Philippines	--	(1)	23	--	(1)	--	--	245	4	--	7	(1)	13	29	321
South Vietnam	--	--	--	--	--	--	--	(1)	--	--	--	--	(1)	--	(1)
Taiwan	--	--	1	(1)	--	--	1	103	3	(1)	7	106	3	32	256
Thailand	--	--	5	--	--	--	--	113	2	1	3	--	4	8	136
U.S. Pacific Islands [3]	--	69	(1)	311	--	368	--	14	3	--	(1)	--	--	--	765
Others	--	(1)	27	--	1	(1)	1	333	12	--	14	251	7	31	677
Total	--	143	204	311	21	370	48	2,629	38	4	103	13,859	444	363	18,537
Total 1974 exports	1,074	1,013	1,300	969	36	855	4,969	11,936	410	9,038	879	41,244	5,561	1,207	80,491

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p Preliminary.

[1] Less than ½ unit.

[3] Data reported to the Bureau of Mines by shippers.

Table 61.—Crude refined products, plant condensate, and unfinished oils imported into the United States, by month [1]

(Thousand barrels)

Year and class	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
1973													
Crude petroleum	84,693	80,433	98,021	91,459	99,654	96,618	108,530	111,368	104,117	115,905	103,570	89,633	1,183,996
Petroleum products:													
Motor gasoline	1,841	2,667	2,193	1,902	3,146	5,214	4,110	5,091	3,816	6,020	6,492	6,267	48,759
Jet fuel:													
Naphtha-type	777	440	394	846	681	926	981	1,858	1,219	2,218	1,695	1,280	13,315
Kerosine-type	6,380	5,759	4,330	3,507	5,846	3,981	6,196	3,715	5,829	5,418	6,546	6,735	64,242
Total jet fuel	7,157	6,199	4,724	4,353	6,527	4,907	7,177	5,573	7,048	7,636	8,241	8,015	77,557
Liquefied gases:													
Butane	2,281	1,926	1,799	1,224	1,915	1,117	1,603	2,305	1,693	2,103	2,307	1,938	22,211
Propane	4,034	3,391	2,759	1,473	1,596	1,156	1,080	1,709	1,268	2,507	2,813	2,005	25,791
Total liquefied gases	6,315	5,317	4,558	2,697	3,511	2,273	2,683	4,014	2,961	4,610	5,120	3,943	48,002
Kerosine	6	4	12	--	6	8	--	224	156	--	245	124	785
Distillate fuel oil	11,289	20,474	18,672	7,207	8,301	6,660	9,870	8,915	9,399	13,978	14,769	13,615	143,149
Residual fuel oil	62,591	60,111	68,062	51,160	51,707	52,824	49,518	59,313	55,471	49,509	59,365	56,594	676,225
Petrochemical feedstocks	318	580	191	324	216	358	214	429	171	331	279	414	3,825
Special naphthas	7	4	33	5	6	6	9	5	5	--	5	3	88
Lubricants	210	160	230	205	35	119	121	217	170	113	333	178	2,091
Wax	100	61	103	94	71	90	62	124	86	92	108	76	1,067
Asphalt	398	304	428	269	682	372	1,306	1,118	1,139	733	726	969	8,444
Plant condensate	3,367	3,411	3,507	3,340	3,205	2,622	3,472	3,419	3,204	3,096	3,464	3,237	39,344
Unfinished oils	3,278	2,479	4,181	4,786	4,002	4,642	4,475	4,515	4,601	3,588	4,953	4,661	50,161
Total petroleum products	96,877	101,771	106,894	76,342	81,415	80,095	83,017	92,957	88,227	89,706	104,100	98,096	1,099,497
Total crude and products	181,570	182,204	204,915	167,801	181,069	176,708	191,547	204,325	192,344	205,611	207,670	187,729	2,283,493
1974 p													
Crude petroleum	73,839	62,940	76,329	98,011	121,139	117,747	126,835	121,634	113,907	118,096	118,739	119,939	1,269,155
Petroleum products:													
Motor gasoline	5,047	5,163	6,960	7,790	7,754	6,324	6,562	7,849	6,056	5,303	5,224	4,370	74,402
Jet fuel:													
Naphtha-type	145	26	292	529	1,417	816	1,206	1,553	1,449	802	987	784	10,006
Kerosine-type	4,065	2,073	4,009	3,436	4,946	3,413	5,435	4,839	5,053	4,180	3,206	4,735	49,390
Total jet fuel	4,210	2,099	4,301	3,965	6,363	4,229	6,641	6,392	6,502	4,982	4,193	5,519	59,396
Liquefied gases:													
Butane	2,552	2,102	1,705	1,715	1,395	2,544	2,013	1,637	1,500	1,628	1,721	2,736	23,248
Propane	3,829	2,688	2,011	1,674	2,238	1,050	624	980	796	1,753	1,538	2,333	21,464

Total liquefied gases	6,381	4,790	3,716	3,389	3,633	3,594	2,637	2,567	2,296	3,381	3,259	5,069	44,712
Kerosine	182	365	232	158	--	130	41	158	21	85	218	159	1,744
Distillate fuel oil	13,905	8,196	8,288	6,490	8,409	6,853	6,648	3.451	4,308	6,618	13,288	16,021	102,475
Residual fuel oil	53,704	53,831	51,892	47,623	41,957	46,478	44,408	47,416	41,999	45,394	49,087	49,963	573,752
Petrochemical feedstocks	701	481	323	362	196	83	255	167	443	421	571	361	4,364
Special naphthas	5	162	151	256	277	--	1	1	1	82	1	1	938
Lubricants	210	171	215	118	108	239	139	137	150	153	90	56	1,786
Wax	99	73	90	75	101	85	86	114	46	59	62	66	956
Asphalt	1,028	1,167	859	1,375	2,622	769	650	654	641	736	419	332	11,252
Miscellaneous	--	--	--	--	--	--	24	256	127	220	13	15	655
Plant condensate	3,054	3,433	3,238	3,050	2,000	2,387	2,427	2,488	2,693	2,825	2,718	2,051	32,364
Unfinished oils	3,632	3,315	5,063	6,443	6,564	3,634	3,805	3,799	1,456	2,300	1,977	2,240	44,228
Total petroleum products	92,158	83,246	85,328	81,094	79,984	74,805	74.324	75.444	66.739	72,559	81,120	86,223	953,024
Total crude and products	165,997	146,186	161,657	179,105	201,123	192,552	201,159	197,078	180,646	190,655	199,859	206,162	2,222,179

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[p] Preliminary.

[1] Imports for onshore use of military jet fuel, distillate and residual fuel oils, and receipts from Puerto Rico, the Virgin Islands, and Guam included in these data are based on figures reported to the U.S. Department of the Interior. All other import figures are compiled from U.S. Department of Commerce data.

Table 62.—Crude oil and petroleum products[1] imported into the United States, by country and receiving PAD district

(Thousand barrels)

Country and PAD district	Crude oil	Gasoline	Special naphtha	Kerosine	Distillate fuel oil[2]	Residual fuel oil[3]	Jet fuel		Liquefied gases	Plant condensate	Asphalt	Unfinished oils	Lubricants	Wax	Petrochemical feedstocks	Total
							Naphtha-type	Kerosine-type								
1973																
North America:																
Canada	365,370	4,432	88	25	2,198	35,639	--	2,944	31,653	39,329	506	1,183	3	35	163	483,568
Mexico	489	--	--	--	196	948	--	--	--	--	--	4,048	--	36	--	5,717
Total	365,859	4,432	88	25	2,394	36,587	--	2,944	31,653	39,329	506	5,231	3	71	163	489,285
Central America and Caribbean:																
Bahamas	--	--	--	--	8,215	46,553	30	7,423	--	--	--	1,103	--	--	169	63,493
El Salvador	--	--	--	--	--	--	--	--	--	--	42	--	--	--	--	42
Leeward and Windward Islands	--	290	--	--	139	484	--	--	--	--	--	--	--	--	--	913
Netherlands Antilles	--	5,716	--	--	23,602	155,577	1,111	19,080	235	--	5,099	2,982	--	--	--	213,402
Panama	--	327	--	124	791	79	35	1,139	--	--	--	--	--	--	--	2,495
Puerto Rico	--	18,816	--	--	8,526	--	--	292	--	--	--	5,376	1,972	691	639	36,312
Virgin Islands	--	5,169	--	11	23,395	79,179	2,824	--	--	--	--	9,296	--	--	341	120,215
Total	--	30,318	--	135	64,668	281,872	4,000	27,934	235	--	5,141	18,757	1,972	691	1,149	436,872
South America:																
Argentina	--	--	--	--	--	154	--	--	--	--	--	--	--	3	--	157
Bolivia	891	--	--	--	--	--	--	--	--	--	--	--	--	--	--	891
Brazil	--	--	--	--	1,433	1,856	--	--	--	--	--	--	--	9	--	3,298
Chile	--	--	--	--	--	--	--	--	138	--	--	--	--	--	--	138
Colombia	778	--	--	--	993	1,378	--	--	--	--	--	31	--	49	--	3,229
Ecuador	17,229	--	--	--	--	397	--	--	--	--	--	60	--	--	--	17,686
Peru	--	--	--	--	552	1,450	--	--	--	--	--	--	--	--	--	2,002
Trinidad	21,739	1,175	--	--	4,867	50,092	3,003	8,542	--	--	19	2,573	--	--	976	92,986
Venezuela	125,742	2,706	--	--	22,511	220,185	2,937	9,733	12,799	15	2,677	13,953	--	--	985	414,243
Total	166,379	3,881	--	--	30,356	275,512	5,940	18,275	12,937	15	2,696	16,617	--	61	1,961	534,630
Europe:																
Belgium	--	884	--	--	1,854	4,069	--	267	97	--	--	225	51	--	--	7,447
Denmark	--	--	--	--	554	--	--	--	--	--	--	--	--	--	--	554
France	--	--	--	--	149	1,218	--	--	225	--	--	--	2	1	--	1,595
Greece	--	160	--	--	590	830	--	--	--	--	--	774	59	--	--	2,413
Italy	--	1,811	--	152	9,440	32,819	--	1,148	--	--	--	400	--	--	--	45,770
Netherlands	--	2,000	--	--	13,260	3,440	--	6	237	--	101	39	1	--	304	19,388
Norway	--	--	--	--	--	250	--	--	103	--	--	--	--	--	--	353
Romania	--	619	--	--	1,734	639	--	--	--	--	--	--	--	--	--	2,992
Spain	--	417	--	--	5,012	3,702	--	282	--	--	--	--	--	--	--	9,413
Sweden	--	--	--	--	480	567	--	--	--	--	--	--	--	--	--	1,047
Turkey	--	1,122	--	--	150	--	--	--	--	--	--	--	--	--	--	1,272
United Kingdom	--	260	--	--	2,038	2,145	--	90	856	--	--	186	--	8	--	5,583
U.S.S.R	--	640	--	473	5,351	1,970	--	157	--	--	--	912	--	--	--	9,503
West Germany	--	156	--	--	349	935	--	--	--	--	--	334	2	20	--	1,796
Total	--	8,069	--	625	40,961	52,584	--	1,950	1,518	--	101	2,870	115	29	304	109,126

Middle East:																
Bahrain	--	--	--	--	748	809	632	973	--	--	--	879	--	--	--	4,041
Iran	78,990	283	--	--	53	10	60	1,511	118	--	--	281	--	--	--	81,306
Iraq	1,529	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1,529
Israel	309	--	--	--	--	--	--	--	--	--	--	--	--	--	--	309
Kuwait	15,208	273	--	--	1,171	--	--	--	2	--	--	324	--	--	--	16,978
Oman	--	--	--	--	53	--	--	--	38	--	--	--	--	--	--	91
Qatar	2,663	--	--	--	--	--	--	--	--	--	--	--	--	--	--	2,663
Saudi Arabia	168,525	155	--	--	377	1,754	1,271	652	595	--	--	3,881	--	--	88	177,298
United Arab Emirates	25,764	--	--	--	--	--	--	--	9	--	--	--	--	--	--	25,773
Yemen	--	--	--	--	--	--	--	676	--	--	--	--	--	--	--	676
Total	292,988	711	--	--	2,402	2,573	1,963	3,812	762	--	--	5,365	--	--	88	310,664
Asia:																
Burma	--	--	--	--	--	--	--	--	--	--	--	--	--	3	--	3
China, People's Republic of	--	--	--	--	--	--	--	--	--	--	--	--	--	13	--	13
Indonesia	73,055	--	--	--	--	4,575	--	--	7	--	--	--	--	42	160	77,839
Japan	--	279	--	--	123	2	69	2,341	--	--	--	220	1	136	--	3,171
Malaysia	234	--	--	--	362	538	364	2,699	147	--	--	--	--	--	--	4,344
Pakistan	--	--	--	--	--	--	--	--	--	--	--	133	--	--	--	133
Philippines	--	--	--	--	--	--	--	17	--	--	--	--	--	--	--	17
Singapore	--	411	--	--	442	--	507	3,446	1	--	--	746	--	18	--	5,571
Taiwan	--	--	--	--	--	--	188	186	--	--	--	--	--	--	--	374
Thailand	--	--	--	--	--	--	67	111	--	--	--	--	--	--	--	178
Total	73,289	690	--	--	927	5,115	1,195	8,800	155	--	--	1,099	1	212	160	91,643
Africa:																
Algeria	43,619	--	--	--	963	4,674	--	312	55	--	--	--	--	--	--	49,623
Angola	17,753	--	--	--	--	140	--	--	--	--	--	--	--	--	--	17,893
Canary Islands	--	162	--	--	--	--	--	--	--	--	--	--	--	--	--	162
Chad	--	--	--	--	--	--	--	--	1	--	--	--	--	--	--	1
Egypt	5,296	--	--	--	--	--	--	--	--	--	--	--	--	--	--	5,296
Ghana	--	--	--	--	--	648	--	--	--	--	--	--	--	--	--	648
Kenya	--	--	--	--	--	1	--	--	--	--	--	--	--	--	--	1
Liberia	--	--	--	--	--	--	--	--	54	--	--	--	--	--	--	54
Libya	48,585	--	--	--	--	10,814	--	--	594	--	--	--	--	--	--	59,993
Nigeria	163,687	--	--	--	--	3,793	--	--	--	--	--	--	--	--	--	167,480
South Africa, Republic of	--	--	--	--	--	--	--	--	--	--	--	--	--	3	--	3
Sudan	--	98	--	--	--	--	--	--	--	--	--	--	--	--	--	98
Tunisia	6,541	--	--	--	--	--	--	--	--	--	--	--	--	--	--	6,541
Total	285,481	260	--	--	963	20,070	--	312	704	--	--	--	--	3	--	307,793
Oceania:																
Australia	--	--	--	--	226	--	63	176	38	--	--	126	--	--	--	629
Hawaii Trade Zone	--	398	--	--	252	1,912	154	39	--	--	--	96	--	--	--	2,851
Total	--	398	--	--	478	1,912	217	215	38	--	--	222	--	--	--	3,480
Total 1973 imports	1,183,996	48,759	88	785	143,149	676,225	13,315	64,242	48,002	39,344	8,444	50,161	2,091	1,067	3,825	2,283,493
Imports by PAD district:																
District I	466,074	42,603	6	785	125,210	639,611	10,000	34,829	8,571	1,777	8,093	26,216	1,980	883	359	1,366,997
District II	260,368	854	80	--	1,353	6,068	--	2,697	18,417	24,403	76	739	1	36	--	315,092
District III	145,654	3,510	--	--	12,406	10,471	--	6,073	9,271	--	275	10,681	110	132	3,466	202,049
District IV	16,132	568	2	--	104	--	--	--	5,496	10,115	--	--	--	--	--	32,417
District V	295,768	1,224	--	--	4,076	20,075	3,315	20,643	6,247	3,049	--	12,525	--	16	--	366,938

See footnotes at end of table.

Table 62.—Crude oil and petroleum products [1] imported into the United States, by country and receiving PAD district—Continued

(Thousand barrels)

Country and PAD district	Crude oil	Gasoline	Special naphtha	Kerosine	Distillate fuel oil [2]	Residual fuel oil [2]	Jet fuel: Naphtha-type	Jet fuel: Kerosine-type	Liquefied gases	Plant condensate	Asphalt	Unfinished oils	Lubricants	Wax	Petrochemical feedstocks	Miscellaneous oil	Total
1974 p																	
North America:																	
Canada	288,763	1,581	907	15	2,469	27,588	5	2,663	30,384	31,840	504	2,836	49	84	--	--	389,688
Mexico	597	--	--	--	316	869	--	--	--	--	2	1,261	--	20	--	--	3,065
Total	289,360	1,581	907	15	2,785	28,457	5	2,663	30,384	31,840	506	4,097	49	104	--	--	392,753
Central America and Caribbean:																	
Bahamas	--	--	--	--	5,547	40,224	--	3,794	--	--	--	8,330	--	--	51	198	58,144
British West Indies	--	197	--	--	248	1,055	--	--	--	--	--	--	--	--	--	--	1,500
Guatemala	--	1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1
Netherlands Antilles	--	5,888	--	--	16,644	132,538	960	16,522	575	--	8,912	3,132	--	--	815	--	185,986
Panama	--	336	--	--	393	--	28	502	--	--	2	--	--	--	--	--	1,261
Puerto Rico	--	16,424	--	21	9,225	1,823	--	218	--	--	--	2,811	1,479	607	284	115	33,007
Virgin Islands	--	16,415	--	700	16,937	103,121	4,052	--	--	--	--	893	--	--	843	--	142,961
Total	--	39,261	--	721	48,994	278,761	5,040	21,036	575	--	8,914	15,166	1,479	607	1,993	313	422,860
South America:																	
Bolivia	2,467	--	--	--	--	--	--	20	--	--	--	--	--	--	--	--	2,487
Brazil	--	--	--	--	--	745	--	--	--	--	--	--	--	--	--	--	745
Colombia	--	163	--	--	344	1,222	--	--	--	--	--	--	34	25	--	--	1,788
Ecuador	15,225	--	--	--	--	150	--	--	--	--	--	--	--	--	--	--	15,375
Peru	--	--	--	--	--	1,587	--	--	--	--	--	--	--	--	--	--	1,587
Trinidad	23,045	5,960	--	41	8,266	40,628	2,978	5,408	--	--	9	62	65	6	1,231	342	88,041
Venezuela	116,437	3,955	--	--	16,106	181,414	838	7,782	11,634	524	1,822	16,639	--	--	383	--	357,534
Total	157,174	10,078	--	41	24,716	225,746	3,816	13,210	11,634	524	1,831	16,701	99	31	1,614	342	467,557
Europe:																	
Belgium	--	858	--	--	1,034	795	--	29	--	--	--	--	57	--	--	--	2,773
Finland	--	1,532	--	--	132	--	--	--	--	--	--	--	--	--	--	--	1,664
France	--	913	--	--	216	538	--	--	--	--	--	346	7	--	--	--	2,020
Greece	--	322	--	--	--	280	--	140	--	--	--	566	58	--	335	--	1,701
Italy	--	5,949	--	157	6,070	12,076	7	1,325	--	--	--	1,016	--	--	--	--	26,600
Netherlands	--	5,184	--	53	7,187	2,280	--	470	276	--	--	277	7	32	--	--	15,766
Norway	322	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	322
Portugal	--	--	--	--	--	216	--	--	--	--	--	--	--	--	--	--	216
Romania	--	1,975	--	--	462	1,229	--	--	--	--	--	621	--	--	--	--	4,287
Spain	--	789	--	--	1,281	881	--	215	--	--	1	1,077	--	--	--	--	4,244
Switzerland	--	--	--	--	--	--	--	--	--	--	--	--	1	--	--	--	1
Turkey	--	1,009	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1,009
U.S.S.R	--	988	--	757	3,347	930	--	--	--	--	--	301	--	2	422	--	6,747
United Kingdom	--	43	--	--	1,246	1,341	--	--	84	--	--	42	3	8	--	--	2,767
West Germany	--	154	--	--	1,999	726	--	--	--	--	--	--	--	18	--	--	2,897
Total	322	19,716	--	967	22,974	21,292	7	2,179	360	--	1	4,246	133	60	757	--	73,014

Middle East:																	
Bahrain	--	1,484	--	--	974	6	291	1,748	--	--	--	--	--	--	--	--	4,503
Iran	168,956	171	--	--	107	226	13	1,270	13	--	--	365	--	--	--	--	171,121
Israel	--	--	--	--	--	9	--	--	--	--	--	--	--	--	--	--	9
Kuwait	1,820	--	--	--	155	--	--	--	--	--	--	--	--	--	--	--	1,975
Oman	236	--	--	--	--	--	--	25	16	--	--	--	--	--	--	--	277
Qatar	6,189	159	--	--	--	--	--	--	--	--	--	--	--	--	--	--	6,348
Saudi Arabia	159,827	353	--	--	761	2,572	297	754	1,577	--	--	1,958	--	--	--	--	168,099
United Arab Emirates	25,158	--	--	--	1	372	--	--	--	--	--	220	--	--	--	--	25,751
Yemen	--	--	--	--	--	--	--	252	1	--	--	--	--	--	--	--	253
Total	362,186	2,167	--	--	1,998	3,185	601	4,049	1,607	--	--	2,543	--	--	--	--	378,336
Asia:																	
Brunei	--	--	--	--	--	--	--	14	--	--	--	--	--	--	--	--	14
India	--	--	--	--	--	--	--	--	--	--	--	--	--	5	--	--	5
Indonesia	103,482	--	--	--	49	5,051	57	55	32	--	--	769	--	69	--	--	109,564
Japan	--	42	--	--	5	--	--	374	--	--	--	--	26	29	--	--	476
Korea	--	--	--	--	--	--	--	148	--	--	--	--	--	--	--	--	148
Malaysia	510	--	--	--	185	323	99	3,233	24	--	--	--	--	--	--	--	4,374
Philippines	--	--	--	--	--	2	--	--	--	--	--	--	--	--	--	--	2
Singapore	--	--	--	--	--	--	--	2,358	35	--	--	152	--	14	--	--	2,559
Taiwan	--	--	--	--	--	--	--	--	--	--	--	30	--	--	--	--	30
Total	103,992	42	--	--	239	5,376	156	6,182	91	--	--	951	26	117	--	--	117,172
Africa:																	
Algeria	65,764	141	--	--	210	3,098	--	35	--	--	--	144	--	--	--	--	69,392
Angola	17,536	--	--	--	--	453	--	--	--	--	--	--	--	--	--	--	17,989
Congo (Brazzaville)	670	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	670
Egypt	3,227	--	--	--	--	7	--	--	--	--	--	--	--	--	--	--	3,234
Gabon	8,552	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	8,552
Ghana	--	--	--	--	142	1,248	--	--	--	--	--	--	--	--	--	--	1,390
Libya	1,495	--	--	--	--	113	--	--	--	--	--	--	--	--	--	--	1,608
Nigeria	254,358	--	--	--	78	5,751	--	33	55	--	--	4	--	--	--	--	260,279
South Africa, Republic of	--	--	--	--	--	--	--	--	--	--	--	--	--	37	--	--	37
Tunisia	4,519	--	--	--	144	--	--	--	--	--	--	--	--	--	--	--	4,663
Total	356,121	141	--	--	574	10,670	--	68	55	--	--	148	--	37	--	--	367,814
Oceania:																	
Australia	--	--	--	--	--	265	--	--	--	--	--	--	--	--	--	--	265
Guam	--	--	--	--	--	--	128	--	--	--	--	--	--	--	--	--	128
Hawaii Trade Zone	--	1,416	31	--	195	--	253	3	6	--	--	376	--	--	--	--	2,280
Total	--	1,416	31	--	195	265	381	3	6	--	--	376	--	--	--	--	2,678
Total 1974 imports	1,269,155	74,402	938	1,744	102,475	578,752	10,006	49,390	44,712	32,364	11,252	44,228	1,786	956	4,364	655	2,222,179
Imports by PAD district:																	
District I	428,608	64,176	2	1,453	93,718	532,350	6,769	27,789	5,958	2,908	10,785	14,084	1,547	847	826	655	1,192,465
District II	250,771	451	905	--	626	7,930	--	1,575	19,304	19,012	38	1,155	32	3	--	--	301,802
District III	289,999	6,851	--	291	5,569	11,805	861	2,987	9,307	126	418	19,208	173	88	3,538	--	351,221
District IV	16,579	322	--	--	46	2	--	--	5,535	8,250	--	--	4	--	--	--	30,738
District V	283,198	2,602	31	--	2,521	21,665	2,376	17,039	4,608	2,073	11	9,781	30	18	--	--	345,953

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p Preliminary.

[1] Imports of crude oil, unfinished oils, and plant condensate are reported to the Bureau of Mines. All other import data are compiled from U.S. Department of Commerce and Federal Energy Administration data.

[2] Includes quantities imported duty-free for supply of vessels and aircraft engaged in foreign trade.

Table 63.—Crude petroleum: World production by country

(Thousand 42-gallon barrels)

Country	1972	1973	1974 [p]
North America:			
Canada	560,693	648,348	616,582
Cuba •	775	775	775
Mexico [1]	185,011	191,482	238,271
Trinidad and Tobago	51,719	60,666	68,131
United States [1]	3,455,368	3,360,903	3,202,585
South America:			
Argentina	158,464	153,589	151,110
Barbados	31	10	48
Bolivia	15,967	17,266	16,603
Brazil	61,088	62,122	64,751
Chile	12,527	11,429	10,055
Colombia	71,674	66,844	60,867
Ecuador	28,579	76,221	63,678
Peru	23,635	25,767	28,069
Venezuela	1,178,487	1,228,594	1,086,332
Europe:			
Albania	10,508	14,058	15,045
Austria	17,284	17,982	15,609
Bulgaria	1,825	1,460	1,095
Czechoslovakia	1,322	1,221	1,085
Denmark	622	1,460	689
France	10,811	9,152	7,863
Germany, East	2,300	2,500	2,500
Germany, West	51,271	47,944	44,718
Hungary	15,084	15,176	15,237
Italy	7,850	7,082	6,956
Netherlands	10,885	10,169	10,227
Norway	12,126	11,166	12,707
Poland	2,574	2,908	4,080
Romania	105,296	106,578	107,964
Spain	1,020	5,932	14,334
U.S.S.R. [1]	2,895,900	3,094,350	3,378,650
United Kingdom	2,628	2,946	3,289
Yugoslavia	23,709	24,680	25,613
Africa:			
Algeria	384,858	400,515	368,139
Angola	51,405	58,910	61,392
Congo (Brazzaville)	2,522	12,713	22,434
Egypt	84,693	60,483	53,715
Gabon	45,671	55,045	73,548
Libya	819,619	793,839	555,291
Morocco	216	320	191
Nigeria	665,282	749,820	823,347
Tunisia	31,607	29,828	31,841
Asia:			
Bahrain	25,508	24,948	24,597
Brunei	67,008	78,678	70,338
Burma	7,466	7,514	7,581
China, People's Republic of •	216,080	365,000	474,500
India	56,965	55,388	55,733
Indonesia	395,581	488,536	501,838
Iran	1,838,825	2,139,229	2,197,901
Iraq	529,419	736,607	720,729
Israel • [2]	43,920	32,193	36,500
Japan	5,242	5,142	4,936
Kuwait [3]	1,201,346	1,102,446	929,678
Malaysia (Sarawak)	33,867	33,054	29,537
Oman	103,131	106,926	106,046
Pakistan	3,294	2,871	2,923
Qatar	176,545	208,152	189,348
Saudi Arabia [3]	2,202,049	2,772,590	3,095,640
Syrian Arab Republic	45,209	38,170	45,352
Taiwan	910	1,055	1,321
Thailand [3]	47	45	42
Turkey	24,416	24,273	24,555
United Arab Emirates:			
Abu Dhabi	384,190	479,192	516,110
Dubai	55,942	80,207	100,375
Oceania:			
Australia	119,516	142,277	140,396
New Zealand [1]	1,119	1,290	1,385
Total	18,600,501	20,367,981	20,537,727

• Estimate. [p] Preliminary.

[1] Includes field condensate.

[2] Estimates of Israeli production from Sinai peninsula oilfields included with Israel rather than with Egypt.

[3] Data for both Kuwait and Saudi Arabia include those countries share of production from the Kuwait-Saudi Arabia Partitioned Zone.

Phosphate Rock

By W. F. Stowasser[1]

Estimated world production in 1974 was approximately 122 million short tons, an increase of about 12% over the 1973 production level. This was the highest annual production recorded and probably the highest annual growth rate. For the fourth consecutive year, world demand exceeded production, further reducing world stocks.

In the United States, the average unit value of phosphate rock increased from $5.66 per ton f.o.b. plant in 1973 to $10.98 per ton f.o.b. plant. World export prices for phosphate rock and fertilizer increased several times during the year and attained levels that were not predictable a year ago. The high prices of phosphate rock and continuing strong demand from world markets promoted plans to increase production from existing mines and from new mining areas. The demand for food from an exploding world population is believed to be the principal cause for the unprecedented demand for phosphatic fertilizers. Although the world population was only 1 billion in 1830, it increased to 2 billion by 1930, to 3 billion by 1960, and to over 4 billion by 1974. This accelerating population rate was the result of a declining death rate without a compensating corresponding decrease in the birth rate. The problems of feeding today's population, particularly in developing countries, are well documented. These problems are expected to intensify as the population increases to about 6 billion to 8 billion by the year 2000.

Although it is possible to double and triple yields per acre of corn, wheat, and rice with the application of chemical fertilizers, it is also necessary to furnish more water from extensive irrigation systems, power for pumps, and herbicides to control weeds. An infrastructure is required to store and distribute larger crops. Much progress in these areas was made in the 1960's but in 1972 a series of events started that reduced the world's ability to feed its population. Unfavorable weather in 1972 reduced crop yields in the U.S.S.R., the People's Republic of China, the Indian subcontinent, and a zone in Africa south of the Sahara. In 1973, harvests in the world improved but not enough to meet the demand for food. In 1974 the world prices of petroleum products and phosphatic fertilizers increased 3 to 4 times compared with the prices existing 1 to 2 years ago. The increase in the price of energy and fertilizer feedstocks put the "green revolution" out of financial reach of many developing countries and contributed to the increased cost of producing food in the developed countries.

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[1] Physical scientist, Division of Nonmetallic Minerals.

Table 1.—Salient phosphate rock statistics
(Thousand short tons and thousand dollars)

	1970	1971	1972	1973	1974
United States:					
Mine production	125,514	125,752	126,651	139,713	155,847
Marketable production	38,739	38,886	40,831	42,137	45,686
Value	$203,218	$203,828	$207,910	$238,667	$501,429
Average per ton	$5.25	$5.24	$5.09	$5.66	$10.98
Sold or used by producers	38,765	40,291	43,755	45,043	48,435
Value	$203,810	$211,986	$223,005	$254,846	$529,141
Average per ton	$5.26	$5.26	$5.10	$5.66	$10.92
Exports [1]	11,738	12,587	14,275	13,875	13,897
P_2O_5 content	3,796	4,126	4,673	4,502	4,468
Value	$59,980	$64,841	$75,376	$82,983	$194,015
Average per ton	$5.11	$5.15	$5.28	$5.98	$13.96
Imports for consumption	136	84	55	65	182
Value	$3,790	$2,478	$1,416	$1,288	$8,999
Average per ton	$27.87	$29.50	$25.75	$19.82	$49.45
Consumption, apparent [2]	27,163	27,788	29,535	31,233	34,720
World: Production	93,635	[r] 96,040	[r] 99,287	[r] 108,858	121,601

[e] Estimate. [r] Revised.

[1] From table 5.

[2] Measured by sold or used plus imports minus exports.

Legislation and Government Programs.—With companies planning to open new mines on public and private lands in Florida, North Carolina, and several Western States, permission to mine from regulatory bodies controlling county, State, and Federal lands was not frequently granted during 1974. An application to mine phosphate reserves in the Los Padres National Forest of California, made in 1969, has not been approved. Four companies had applied for preference right leases to mine phosphate rock in the Osceola National Forest, in northern Florida, during the 1969 to 1972 period. An Environmental Impact Statement for the Osceola National Forest was completed and published in 1974, however, a decision by the U.S. Department of the Interior to deny or grant the leases was still pending at yearend. A number of applications to mine phosphate rock in the Caribou National Forest of Idaho were made in 1974. These requests were tabled until a regional Environmental Impact Statement could be prepared in compliance with the National Environmental Protection Act.

New mines in North Carolina are regulated by the State Mining Act of 1971 (G.S. 74–46 through 74–68). Permits to mine are issued only after the appplicant furnishes sufficient information to assure that (1) the usefulness, productivity, and scenic values of all lands and waters involved in mining within the State will receive the greatest practical degree of protection and restoration and (2) no mining will be done in the State unless plans for such mining include reasonable provisions for protection of the surrounding environment and for reclamation of the area of land affected by mining. In addition, regulations to provide for management of water withdrawal and use in designated "Capacity Use Areas" must be followed by application for Water Use Permits from the Board of Water and Air Resources.

The State of Florida, Department of Pollution Control, promulgated the rules on air pollution and the Florida Pollution Control Board published the rules on pollution of waters. In addition to State regulations and those of the Southwest Florida Water Management District, the counties to the south and southwest of Polk County, specifically Hillsborough, Manatee, Hardee, and Desoto Counties, adopted ordinances to regulate mining and earthmoving. In Hillsborough County, Ordinance No. 74–6, the "Hillsborough County Phosphate Mining Ordinance," requires submission of an Application for Development Approval of a Development of Regional Impact pursuant to Chapter 380, Florida Statutes, a mining and reclamation plan, evidence of financial responsibility, and copies of applications to and approvals from all applicable Federal, State, and local agencies.

The rules and regulations of the Hillsborough County phosphate mining ordinance are highlighted in the Construction and Operation and Reclamation Sections. Neither mining nor settling ponds will be permitted within 500 feet of a public park boundary, residences, or land zoned for residences; within 200 feet of public right-of-way or private easement for drainage, utility, or road purposes; and must be 200 feet from permittee's property line. Control of excavated material placement and height, noise levels, soil vibration levels, blasting, and ground water withdrawal is planned. Diversion of natural streams or lakes will be restricted. Construction on the 25-year flood elevation of surface water courses and mining or placement of fill on the 25- to 100-year flood elevation will be permitted only if the permittee can show that countermeasures will insure a reduction of the net effect of water surface elevation of all floods. All dams for settling or thickening ponds will be located, designed, constructed, and maintained in compliance with the rules and regulations of the State Department of Pollution Control. Slimes will be impounded in settling ponds and will be fenced and posted. Air quality and rainfall will be monitored on the permittee's property.

Mined-out lands not covered by settling ponds and settling ponds on mined-out lands or on natural ground are to be reclaimed under separate regulations. Mined-out land will be reclaimed to sufficiently level surfaces to support farm and agricultural activities; the ratio of slopes will not exceed one vertical to six horizontal; and lands will be revegetated. Permanent water bodies created will conform to specified slopes, depths, and drainage. Reclamation will be completed within 1 year after ending mining in a unit. Areas placed into settling ponds will be considered reclaimed when all provisions described for mined-out land are met. A time limit is not specified but permittees are expected to show the schedule in the Mining and Reclamation Plan.

The ordinances of the other counties are similar and, in some instances, more specific than Hillsborough County's ordinance. These are available from the respective Boards of County Commissioners.

On October 22, 1974 the Environmental Protection Agency (EPA) published in the Federal Register[2] a notice of proposed rulemaking pursuant to section III of the Clean Air Act, as amended (39 F.R. 37602 Oct. 22, 1974). The proposed regulation establishes standards of performance for new phosphate fertilizer industry plants, including wet process phosphoric acid, superphosphoric acid, diammonium phosphate, and triple superphosphate plants and storage facilities.

The EPA published in the Federal Register[3] the final effluent limitations guidelines for existing sources and standards of performance and pretreatment standards for new sources in the phosphate manufacturing category of point sources, by amending 40 CFR, Chapter I, Subchapter N, and adding a new subpart 422. The provisions of this subpart are applicable to discharges of pollutants from the manufacture of phosphoric acid, phosphorus pentoxide, phosphorus pentasulfide, phosphorus trichloride, and phosphorus oxychloride directly from elemental phosphorus.

DOMESTIC PRODUCTION

Domestic production of marketable phosphate rock was 45,686,000 tons, an increase of 3,549,000 tons, or 8.4%, over that of 1973. The value of the marketable rock was $501,429,000, an increase of 110% over that of 1973. The average grade of phosphate ore mined in the United States was 13.3% P_2O_5, and the average grade of marketable rock was 30.8% P_2O_5. The average weight recovery of concentrate and rock marketable as mined was 29.3%, and the P_2O_5 recovery averaged 67.7%. Of the total marketable production in the United States, Florida and North Carolina produced 36,980,000 tons (80.9%), the Western States produced 6,295,000 tons (13.8%), and Tennessee produced 2,411,000 tons (5.3%).

Florida and North Carolina.—Production of marketable phosphate rock was 36,980,000 tons, an increase of 2,553,000 tons, or 7.4%, over that of 1973. The value of marketable rock was $408,979,000, an increase of $217,325,000, or 113.4%, over that of 1973.

The average grade of phosphate ore mined was 12.5% P_2O_5, and the average grade of marketable rock was 31.4% P_2O_5. The average weight recovery of concentrate and rock marketable as mined was 26%, and the average P_2O_5 recovery was 65.6%. A majority of producers in Florida and North Carolina were able to increase production in 1974; however, the largest increases were posted by International Minerals & Chemical Corp. (IMC) and Texasgulf Inc. International Minerals & Chemical Corp.'s new Phosphoria mine started operating in May. The plant is designed to recover pebble and the concentrate feed is pumped to the Noralyn concentration plant. Texasgulf announced plans for expansion of rock and fertilizer capacity at the Lee Creek mine in North Carolina. Implementation of these plans proceeded in 1974 with erection of a 30-inch hydraulic dredge to remove overburden and a 50-yard dragline.

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[2] Federal Register, v. 39, No. 205, Oct. 22, 1974, pp. 37, 602-37, 607.

[3] Federal Register, v. 39, No. 35, Feb. 20, 1974, pp. 6580-6588.

Agrico Chemical Co., Borden, Inc., Brewster Phosphates, Gardinier, Inc., W. R. Grace & Co., International Minerals & Chemical Corp., Mobil Oil Corp., Poseidon Mines, Inc., Occidental Petroleum Corp., USS Agri-Chemicals, Inc., and Swift Chemical Co. produced marketable rock from Florida land-pebble phosphate fields. Howard Phosphate Co., Kellogg Co., Loncala Phosphate Co., and Manko Co. mined 41,000 tons of soft rock in Florida.

Agrico Chemical Co., a subsidiary of the Williams Companies and Kennecott Copper Corp. announced plans to build a new phosphate mining and manufacturing facility near Washington in Beaufort County, N.C. The mine will be designed to produce 4 to 5 million tons of marketable phosphate rock per year from an estimated 300-million-ton reserve. A 400,000- to 600,000-ton-per-year phosphoric acid plant will be constructed and a million tons of diammonium phosphate and ammonium polyphosphate will be produced at the mine site. A schedule of construction for the mine and plant was not announced. Construction proceeded on Agrico Chemical Co.'s wet phosphate rock handling and loading terminal at the former site of the Big Bend Industrial Park on Hillsborough Bay, Fla. The construction of the Fort Green mine in Polk County, Fla., designed to produce a total of 2 to 2.5 million tons per year of pebble and concentrate, was expected to start by the end of the year. The flotation plant was scheduled to be completed in 1975.

Beker Industries Corp. exercised its options to acquire properties in Manatee County, Fla., with reserves estimated to be 60 million tons. The purchase was completed before the company's attempt to have the Florida Land and Water Adjudicatory Commission override the Manatee County Commission's denial of a development order. The application for a development order was in the appeal process at the end of the year.

The Hillsborough County Commission granted its first mining permit in August to Brewster Phosphates. The site of the proposed phosphate mine is near Fort Lonesome in southeastern Hillsborough County. Of the 18,367 acres in the tract, only 9,793 acres will be mined to extract an estimated 50 million tons of marketable phosphate rock. The mining rate planned is 3 million tons per year with operations scheduled to start in 1976.

Occidental Petroleum Corp. concluded a barter agreement with the U.S.S.R. The details were not published; however, it was understood that the U.S.S.R. will produce and option to purchasers in the United States at world market prices 3.4 million short tons of anhydrous ammonia per year, 1.1 million short tons of potash per year, and from 1.1 to 1.7 million short tons of urea per year. If these commodities are not purchased in the United States, the U.S.S.R. has the option of marketing internationally. The Occidental Petroleum Corp. will furnish 1.1 million short tons of superphosphoric acid per year to the U.S.S.R. The barter is planned to start in 1978 and to terminate in 1998. Occidental Petroleum Corp. will consume about 2.7 million tons per year to satisfy this commitment, or 54 million tons of phosphate rock over the life of the contract.

The Swift Chemical Co. advised the Manatee County Commissioners that it was reviewing plans to obtain approval to mine phosphates from 11,000 acres in the northern part of Manatee County. The application for the mining permit will be made in the near future.[4]

A report discussing the economic significance to Florida and the Nation of the phosphate industry was published.[5]

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[4] Bradenton Herald, July 18, 1974.

[5] Wang, Kung-Lee, B. W. Klein, and A. F. Powell. Economic Significance of the Florida Phosphate Industry. BuMines Inf. Circ. 8653, 1974, 51 pp.

Western States.—Production of marketable phosphate rock was 6,295,000 tons, an increase of 1,097,000 tons over that of 1973, or 21.1%. Agricultural Products Corp. (Beker Industries Corp.), J. R. Simplot Co., and Stauffer Chemical Co. were the companies principally responsible for the increase in production. The value of the marketable rock increased to $73,985,000, or 116% above that of 1973. The average grade of mined phosphate rock was 23.2% P_2O_5. The average grade of rock used direct was 26.4% P_2O_5, and the average grade of beneficiated rock was 32.1% P_2O_5. The average grade of total marketable rock was 28.4% P_2O_5. Of the total rock produced in the Western States, 65.3% was used direct and 34.7% was beneficiated. The weight recovery of the combined beneficiated concentrates and rock used as mined was 65.7%, and the average P_2O_5 recovery was 80.5%.

Agricultural Products Corp., Monsanto Company, J. R. Simplot Co., and Stauffer Chemical Co. mined and processed phosphate rock in Idaho. In Montana, Cominco American, Incorporated, and Rocky Mountain Phosphate Co. recovered phosphate rock from underground mines near Garrison. Stauffer Chemical Co. mined phosphate rock in Wyoming and in two areas in Utah. The Meramec Mining Co., Sullivan, Mo., continued to recover apatite concentrates from its Pea Ridge iron ore mine tailings.

Although none of the producing companies in the Western States announced any new expansion plans in 1974, Earth Sciences, Inc., in a joint venture with National Steel Corp. and Southwire Co., acquired a block of phosphate reserves consisting of seven properties from John and Elizabeth Archer. Plans are to construct a triple superphosphate plant near Cedar City, Utah, and to react the sulfuric acid derived from processing alunite with phosphate rock from the Archer properties. The details of mining, beneficiation, and fertilizer production were not completed.

Valley Nitrogen Products, Inc., secured mining rights from Duval Corp. and Tenneco Corp. on 1,300 acres of land in Wyoming as a possible source of phosphate rock.[6]

International Minerals & Chemical Corp. requested that the Bureau of Land Management approve the mining plan for their existing lease, Husky #1 property, in Idaho. The U.S. Department of the Interior and the U.S. Department of Agriculture determined that the expansion of phosphate mining activity on Federal leases in southeastern Idaho constituted a major Federal action as defined by the National Environmental Policy Act of 1969 and, therefore, requires the preparation of an environmental impact statement. The preparation of an environmental impact statement by the U.S. Departments of the Interior and Agriculture was initiated and is expected to be completed and filed with the Council on Environmental Quality in mid-1976.

Tennessee.—Production of marketable phosphate rock was 2,411,000 tons, a decrease of 101,000 tons, or 4% less than reported in 1973. The value of the marketable rock increased from $12,799,000 in 1973 to $18,465,000 in 1974, an increase of 44.3%.

The average grade of mined ore was 19.9% P_2O_5, the average weight recovery of concentrates was 63.2%, and recovery of P_2O_5 averaged 78.9%. A small quantity of rock was mined by several companies and was used in the electric furnaces without the benefit of beneficiation.

Hooker Chemical & Plastic Corp., Monsanto Industrial Chemical Co., Stauffer Chemical Co., M. C. West, Inc., and the Tennessee Valley Authority mined phosphate rock in Tennessee and reduced the rock in electric furnaces to elemental phosphorus.

M. C. West, Inc., started mining and beneficiating phosphate rock for the merchant market in the second half of 1974.

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[6] Industrial Minerals. No. 89, February 1975, p. 46.

Table 2.—Production of phosphate rock in the United States, by State

(Thousand short tons and thousand dollars)

	Mine production		Mine production used directly		Washer production		Marketable production		
	Rock	P_2O_5 content	Rock	P_2O_5 content	Rock	P_2O_5 content	Rock	P_2O_5 content	Value
1973:									
Florida [1]	127,283	16,319	22	4	34,405	10,972	34,427	10,977	191,654
Tennessee	4,168	894	W	W	W	W	2,512	653	12,799
Western States [2]	8,263	1,800	3,412	901	1,786	576	5,198	1,477	34,214
Total [3]	139,713	19,013	3,434	905	36,191	11,548	42,137	13,106	238,667
1974:									
Florida [1]	142,128	17,712	38	8	36,942	11,611	36,980	11,619	408,979
Tennessee	4,135	821	W	W	W	W	2,411	648	18,465
Western States [2]	9,584	2,220	4,111	1,086	2,184	700	6,295	1,786	73,985
Total	155,847	20,753	4,149	1,094	39,126	12,311	45,686	14,053	501,429

W Withheld to avoid disclosing individual company confidential data.

[1] Includes North Carolina.

[2] Includes Idaho, Missouri, Montana, Utah, and Wyoming.

[3] Data may not add to totals shown because of independent rounding.

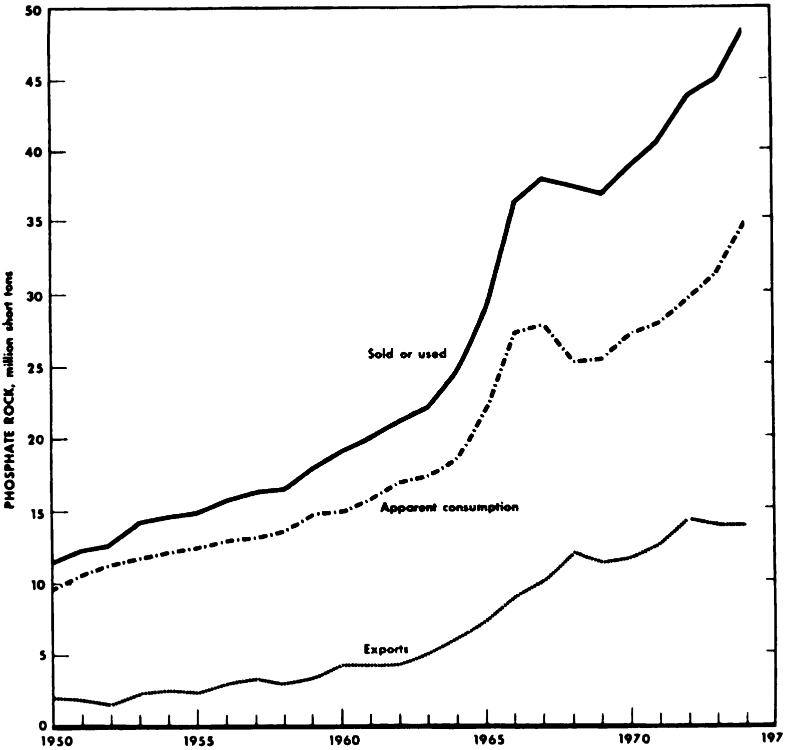

Figure 1.—Phosphate rock (sold or used), apparent consumption, and exports.

CONSUMPTION AND USES

Apparent consumption of marketable phosphate rock increased 11.2% above that reported in 1973. According to producers' reports, the quantity of marketable rock sold or used was 48,435,000 tons. This was an increase of 7.5% over the quantity sold or used in 1973. The domestic market consumed 71.3% of this total and 28.7% was exported.

The consumption pattern in the United States was 28,263,000 tons (81.8%) for fertilizer and 5,925,000 tons (17.2%) for elemental phosphorus production. To produce defluorinated rock and other minor purposes 350,000 tons (1.0%) was used.

The percent distribution by grade of marketable rock consumed in the United States is compared with the percent distribution in 1973 in the following tabulation:

Grade	Percent distribution	
percent BPL[1]	1973	1974
Less than 60	8.7	5.6
60–66	11.9	20.8
66–70	40.9	42.0
70–72	12.3	12.2
72–74	16.7	11.6
Over 74	9.5	7.8

[1] 1.0% BPL (bone phosphate of lime or tricalcium phosphate) = 0.458% P_2O_5.

Florida and North Carolina.—The quantity of phosphate rock sold or used increased from 36,916,000 tons in 1973 to 39,920,000 tons in 1974. Of this total sold or used in 1974, 65.9% was consumed in the domestic fertilizer market and the balance, 33.2%, was exported, with a minor quantity used domestically for defluorinated rock, elemental phosphorus and other miscellaneous applications. The consumption pattern of the overall domestic fraction was 26,296,000 tons (98.6%) for fertilizer, 326,000 tons (1.2%) for defluorinated rock, and the balance was converted into elemental phosphorus or used for other minor purposes.

The percent distribution by grade of marketable rock sold or used from Florida and North Carolina in 1974 compared with that of 1973 follows:

Grade	Percent distribution	
percent BPL[1]	1973	1974
Less than 60	0.3	0.2
60–66	9.7	17.0
66–70	45.9	47.2
70–72	14.1	14.3
72–74	18.5	11.9
Over 74	11.5	9.4

[1] 1.0% BPL (bone phosphate of lime or tricalcium phosphate) = 0.458% P_2O_5.

Western States.—The quantity of marketable rock sold or used increased 8.2% compared with the quantity sold or used in 1973. Of the total sold or used in 1974, 89.1% was consumed in the domestic market and the balance, 10.9%, was exported. Of the 5,263,000 tons consumed in the domestic market, 37.4% was used for fertilizer and 62.6% was used principally in electric furnaces. A small tonnage was used to produce defluorinated rock.

The percent distribution by grade of marketable rock sold or used from the Western States in 1974 compared with the percent distribution in 1973, is as follows:

Grade	Percent distribution	
percent BPL[1]	1973	1974
Less than 60	37.7	35.8
60–66	22.8	22.5
66–70	20.4	23.5
70–72	6.0	3.5
72–74	12.6	14.3
Over 74	.5	.4

[1] 1.0% BPL (bone phosphate of lime or tricalcium phosphate) = 0.458% P_2O_5.

Tennessee.—The quantity of marketable rock sold or used declined slightly from 2,665,000 tons in 1973 to 2,607,000 tons in 1974. All of this rock was consumed in electric furnaces to produce elemental phosphorus and industrial chemicals. Most of the elemental phosphorus was burned to produce furnace phosphoric acid, the base for sodium tripolyphosphate and dicalcium phosphate, the principal products. A small amount of elemental phosphorus was used to produce anyhydrous derivatives.

The percent distribution by grade of marketable rock sold or used from Tennessee is compared with the percent distribution in 1973 in the following tabulation:

Grade percent BPL[1]	Percent distribution 1973	Percent distribution 1974
Less than 60	66.4	19.7
60–66	19.8	75.6
66–70	12.9	4.7
70–72	--	--
72–74	.9	--
Over 74	--	--

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[1] 1.0% BPL (bone phosphate of lime or tricalcium phosphate) = 0.458% P_2O_5.

Table 3.—Phosphate rock sold or used by producers in the United States, by use

(Thousand short tons)

Use	1973 Rock	1973 P_2O_5 content	1974 Rock	1974 P_2O_5 content
Domestic:				
Fertilizers	25,124	7,876	28,268	8,795
Elemental phosphorus	5,762	1,500	5,925	1,567
Defluorinated rock Other uses	282	94	350	116
Total	31,168	9,470	34,538	10,478
Exports	13,875	4,502	13,897	4,468
Grand total	45,043	13,972	48,435	14,946

Table 4.—Phosphate rock sold or used by producers in the United States, by grade and State in 1974

(Thousand short tons and thousand dollars)

Grades—BPL[1] content (percent)	Florida and North Carolina			Tennessee		
	Rock	P_2O_5 content	Value	Rock	P_2O_5 content	Value
Below 60	99	24	600	W	W	W
60–66	6,776	1,963	51,066	1,970	547	15,633
66–70	18,839	5,839	170,056	W	W	W
70–72	5,711	1,859	68,059	--	--	--
72–74	W	W	W	--	--	--
Plus 74	W	W	W	--	--	--
Total	39,920	12,555	437,158	2,607	708	20,594

Grades—BPL[1] content (percent)	Western States			Total United States		
	Rock	P_2O_5 content	Value	Rock	P_2O_5 content	Value
Below 60	W	W	W	2,725	671	17,710
60–66	1,330	372	8,828	10,076	2,882	75,521
66–70	W	W	W	20,352	6,310	191,330
70–72	206	66	1,458	5,918	1,926	69,516
72–74	W	W	W	5,588	1,846	103,435
Plus 74	W	W	W	3,776	1,312	71,630
Total[2]	5,908	1,683	71,390	48,435	14,946	529,141

W Withheld to avoid disclosing individual company confidential data.

[1] Bone phosphate of lime $Ca_3(PO_4)_2$.

[2] Data may not add to totals shown because of independent rounding.

Table 5.—Phosphate rock sold or used by producers, by use and State

(Thousand short tons)

Use	Florida [1]		Tennessee		Western States		Total [2] United States	
	Rock	P_2O_5 content	Rock	P_2O_5 content	Rock	P_2O_5 content	Rock	P_2O_5 content
1973								
Domestic:								
Agricultural	23,701	7,421	15	5	1,688	544	25,404	7,969
Industrial	W	W	2,649	694	W	W	5,764	1,501
Total [2]	23,701	7,421	2,665	699	1,688	544	31,168	9,470
Exports	W	W	--	--	W	W	13,875	4,502
Total	36,916	11,720	2,665	699	5,462	1,552	45,043	13,972
1974								
Domestic:								
Agricultural	26,621	8,272	--	--	1,991	639	28,612	8,911
Industrial	W	W	2,607	708	W	W	5,926	1,567
Total	26,621	8,272	2,607	708	1,991	639	34,538	10,478
Exports	W	W	--	--	W	W	13,897	4,468
Total	39,920	12,555	2,607	708	5,908	1,683	48,435	14,946

W Withheld to avoid disclosing individual company confidential data.

[1] Includes North Carolina.

[2] Data may not add to totals shown because of independent rounding.

Table 6.—Florida phosphate rock sold or used by producers, by type

(Thousand short tons and thousand dollars)

Year	Land pebble [1]				Soft rock				Total [2]			
	Rock	P_2O_5 content	Value		Rock	P_2O_5 content	Value		Rock	P_2O_5 content	Value	
			Total	Average per ton			Total	Average per ton			Total	Average per ton
1970	31,111	9,981	157,652	$5.07	24	5	168	$7.10	31,134	9,986	157,820	$5.07
1971	33,176	10,621	173,950	5.24	20	4	141	7.19	33,195	10,625	174,091	5.24
1972	36,913	11,863	188,205	5.10	21	4	121	5.87	36,934	11,868	188,326	5.10
1973	36,894	11,716	205,328	5.57	22	4	154	7.00	36,916	11,720	205,482	5.57
1974	39,879	12,547	436,587	10.95	41	8	571	13.93	39,920	12,555	437,158	10.95

[1] Includes North Carolina.

[2] Data may not add to totals shown because of independent rounding.

Table 7.—Tennessee phosphate rock sold or used by producers

(Thousand short tons and thousand dollars)

Year	Rock	P_2O_5 content	Value	
			Total	Average per ton
1970 [1]	3,184	864	15,606	$4.90
1971	2,596	687	12,281	4.73
1972	2,240	587	11,188	4.99
1973	2,665	699	13,812	5.18
1974	2,607	708	20,594	7.90

[1] Includes Alabama.

STOCKS

In Florida and North Carolina, yearend stocks of marketable phosphate rock declined from 8,446,000 tons in 1973 to 5,750,000 tons in 1974. This was the largest percentage decline in stocks over the past 3 years. The decline of 31.9% in 1974 was substantially greater than the 19.2% and 12% stock reductions in 1973 and 1972, respectively.

Significant stocks are not maintained in Tennessee. Sufficient surge is maintained to assure beneficiated rock for the electric furnaces. If merchant rock is produced in the future, it is probable that some stocks will be developed and reported. Stocks are accumulated in the Western States to carry both electric furnace and wet process phosphoric acid plant operations over the winter months when transportation problems develop with frozen ore. Shipments, for the complete year, of ore from mines to plants by either truck or rail are scheduled during the mild temperature months. Significant carryover of stocks from year to year has not been practiced.

PRICES

Prices for various grades of Florida land-pebble phosphate rock published by the Chemical Marketing Reporter are shown in table 8. These prices may be an indication of the current level of new contract prices for land-pebble phosphate rock in the domestic market, since phosphate rock contracts are not published. The price of Tennessee and Western States phosphate rock consumed in electric furnaces also is not published. Acid grade rock that is not exported is, for the most part, consumed by producing companies. A small amount is sold in the merchant market.

The average 1974 unit value[7] of marketable rock as reported by producers, and estimated when unspecified, was $10.98 per ton f.o.b. plant, a significant increase from the $5.66 per ton reported in 1973. The average unit value of land-pebble rock reported sold or used in the domestic market from Florida and North Carolina increased from $5.57 per ton in 1973 to $10.95 per ton in 1974. In the Western States, the unit value of marketable rock sold or used increased from $6.51 per ton in 1973 to $12.08 per ton in 1974. The unit value of marketable rock sold or used in Tennessee increased from $5.18 per ton in 1973 to $7.90 per ton in 1974.

The average unit value of marketable phosphate rock exported from the United States increased from $5.98 per ton in 1973 to $13.96 per ton in 1974. The unit value of marketable rock exported from Florida and North Carolina increased from $5.77 per ton in 1973 to $13.84 per ton in 1974. The unit value of phosphate rock exported from the Western States increased from $9.93 per ton in 1973 to $16.40 per ton in 1974. Tennessee rock was not exported.

The Phosphate Rock Export Association, Tampa, Fla., increased the price of phosphate rock during 1974 as shown in table 9. The Office Cherifien des Phosphates, Morocco, posted price increases during the year for both Khouribga and Youssoufia rock as shown in table 10. It is noted that the Moroccan export price set by the Office Cherifien des Phosphates is maintained about $20 per ton higher than that posted by the Phosphate Rock Export Association. Prices of phosphate rock produced in Senegal and Jordan follow the price schedule published by Morocco; however, Togo has priced its rock at $68 per short ton f.a.s. (free alongside ship) Kpeme.

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[7] Value, if sold, net selling price f.o.b. plant or, if used, estimated value from comparable selling prices or developed price, that is, cost plus overhead and profit.

Table 8.—Prices of Florida land-pebble, washed, dried, and unground in bulk, carlots, at mine

(Per short ton)

Grade, percent BPL	Price
77/76	$33.90
75/74	31.65
72/70	28.55
70/68	26.75
68/66	25.00

Source: Chemical Marketing Reporter. V. 206, No. 26, Dec. 23, 1974, p. 34.

Table 9.—Phosphate Rock Export Association export price schedule f.o.b. Tampa Range or Jacksonville, Fla.

Grade, percent BPL	Price per short ton		
	January 1974	July 1974	October 1974
77/76	$26.79	$42.41	$56.25
75/74	24.56	37.50	49.90
72/70	21.43	32.14	43.55
70/68	19.64	29.47	39.01
68/66	17.85	26.79	35.38
66/64	16.08	24.56	32.66

Table 10.—Office Cherifien des Phosphates export price schedule f.a.s. Casablanca or Safi

Grade, percent BPL	Price per short ton		
	January 1974	July 1974	January 1975
Khouribga:			
77/79 [1]	$42.87	$64.41	$69.40
75/77	38.10	57.15	61.69
70/72	36.29	54.48	58.97
Youssoufia:			
70/72	34.02	51.08	55.11

[1] Calcined.

FOREIGN TRADE

Of the 13,897,000 tons of marketable phosphate rock reported by producers as exported in 1974, 95.4% originated in Florida and North Carolina and the balance, 4.6%, was exported from the Western States. The quantity of marketable rock exported in 1974 was about the same as the 13,875,000 tons exported in 1973. Exports from Florida, the principal source of marketable rock for the export market, did not change significantly compared with 1973 export tonnage. Exports of marketable rock from the Western States declined 8.7% compared with exports in 1973.

The average calculated unit value of exported phosphate rock increased from $5.98 per ton in 1973 to $13.96 per ton in 1974.

Imports in 1974 were 182,000 tons compared with 65,000 tons imported in 1973. Although the percent increase, 180%, was large, the absolute quantity was a minor part of the United States supply. The value of the imported phosphate rock was $8,999,000 and the average unit value was $49.45 per ton. The Bureau of Census reported 43,531 tons was imported from Mexico, 84,353 tons from the Netherlands Antilles, 31,377 tons from the Spanish Sahara, 22,420 from Israel, and a 20-ton sample from Australia.

Table 11.—U.S. exports of phosphate rock, by country

(Thousand short tons and thousand dollars)

Destination	1973		1974	
	Quantity	Value	Quantity	Value
Florida phosphate rock:				
Austria	148	1,295	62	622
Belgium-Luxembourg	958	6,254	1,027	16,607
Brazil	639	5,288	686	15,637
Canada	[r] 2,758	[r] 20,208	3,139	40,695
Chile	78	664	80	3,029
China, People's Republic of	41	451	18	184
Colombia	[r] 89	[r] 724	103	3,194
Ecuador	8	78	14	351
El Salvador	[r] 6	52	14	638
France	487	3,769	348	6,179
Germany, West	1,241	7,868	942	16,190
India	252	1,768	278	4,575
Iran	331	2,703	408	11,073
Italy	601	4,049	472	7,299
Japan	2,165	21,777	2,490	61,058
Korea, Republic of	622	4,456	533	9,229
Mexico	1,071	8,150	966	14,029
Netherlands	599	3,557	878	10,874
Norway	--	--	98	2,549
Peru	13	120	12	260
Philippines	173	1,308	154	3,319
Poland	125	919	302	4,945
Romania	147	1,249	31	677
Spain	163	1,194	81	923
Sweden	93	678	72	1,761
Taiwan	93	1,130	62	1,146
United Kingdom	151	1,112	80	1,666
Uruguay	24	272	--	--
Other	1	18	6	240
Total	13,077	101,111	13,356	238,949
Other phosphate rock: [1]				
Brazil	1	80	(2)	1
Canada	742	10,573	760	14,199
Chile	(2)	(2)	6	188
Colombia	--	--	2	93
Costa Rica	6	65	--	--
Dominican Republic	(2)	15	3	135
El Salvador	10	109	(2)	1
Germany, West	1	23	27	1,145
Japan	9	109	--	--
Korea, Republic of	--	--	14	1,542
Mexico	(2)	3	(2)	7
Netherlands	8	63	1	19
Norway	73	584	--	--
Peru	5	508	--	--
Singapore	--	--	3	293
Venezuela	(2)	14	1	37
Other	(2)	38	1	88
Total	855	12,184	818	17,748
Grand total	13,932	113,295	14,174	256,697

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[r] Revised.

[1] Includes colloidal and sintered matrix, Tennessee, Idaho, Montana, and soft phosphate rock.

[2] Less than ½ unit.

Table 12.—U.S. exports of superphosphates, by country

(Thousand short tons and thousand dollars)

Destination	1973		1974	
	Quantity	Value	Quantity	Value
Algeria	34	2,904	([1])	16
Argentina	21	1,508	9	1,344
Australia	1	43	1	52
Bangladesh	41	3,253	17	5,291
Brazil	341	24,996	340	70,692
Canada	42	2,827	59	3,850
Chile	44	3,419	194	50,070
Colombia	40	3,016	22	3,192
Costa Rica	9	684	4	324
Dominican Republic	14	1,055	16	2,121
Ecuador	10	642	9	1,820
Egypt	9	756	--	--
France	70	3,768	72	5,471
Germany, West	10	695	11	1,184
Guatemala	3	93	([1])	5
Guyana	3	137	4	510
Hong Kong	1	69	([1])	2
Hungary	--	--	13	1,038
Indonesia	22	1,765	124	25,922
Italy	19	1,219	38	1,066
Jamaica	4	192	6	758
Japan	25	1,763	10	1,888
Korea, Republic of	82	7,503	103	26,771
Mexico	1	96	1	99
Netherlands	2	137	([1])	14
New Zealand	([1])	18	7	211
Nicaragua	([1])	12	([1])	97
Peru	4	402	2	523
Philippines	--	--	19	4,367
Singapore	101	6,929	4	534
Sri Lanka	6	425	12	4,070
United Kingdom	1	41	8	664
Venezuela	5	329	18	4,562
Other	2	294	56	4,183
Total	967	70,990	1,179	222,711

[1] Less than ½ unit.

Table 13.—U.S. exports of ammonium phosphates, by country

(Thousand short tons and thousand dollars)

Destination	1973		1974	
	Quantity	Value	Quantity	Value
Afghanistan	12	1,326	--	--
Algeria	45	3,881	--	--
Argentina	41	3,992	34	7,137
Belgium-Luxembourg	16	1,321	55	5,688
Bolivia	5	599	1	222
Brazil	442	38,616	414	72,379
Canada	45	3,208	67	9,173
Chile	120	9,883	84	20,404
China, People's Republic of	48	4,736	--	--
Colombia	39	3,359	29	5,174
Costa Rica	30	2,986	30	5,329
Dominican Republic	23	2,057	38	7,142
Ecuador	14	1,451	41	12,876
El Salvador	36	3,066	50	8,300
Ethiopia	27	2,722	--	--
France	120	9,104	125	16,700
Guatemala	(1)	44	14	1,891
India	399	30,384	403	65,606
Indonesia	11	701	44	13,669
Iran	--	--	16	5,781
Italy	98	7,793	14	1,879
Japan	107	9,228	105	21,847
Kenya	--	--	6	2,210
Lebanon	68	6,140	28	7,664
New Zealand	33	2,687	41	4,281
Nicaragua	24	2,181	10	2,316
Norway	19	573	--	--
Pakistan	232	21,627	12	3,922
Panama	(1)	5	3	655
Peru	9	667	7	1,836
Philippines	11	860	22	4,870
Singapore	2	243	55	6,913
Switzerland	12	793	--	--
Thailand	43	3,535	124	16,343
Uruguay	13	1,274	7	903
Venezuela	6	537	25	8,071
Vietnam, South	18	1,906	67	15,271
Yugoslavia	55	4,574	6	650
Other	12	1,005	15	1,705
Total	2,235	189,064	1,992	358,807

[1] Less than ½ unit.

Table 14.—U.S. exports of mixed chemical fertilizers, by country

(Thousand short tons and thousand dollars)

Destination	1973		1974	
	Quantity	Value	Quantity	Value
Argentina	(1)	5	(1)	17
Belgium-Luxembourg	7	247	62	3,091
Brazil	2	1,086	2	1,112
Canada	72	5,630	73	9,790
Colombia	29	2,139	36	6,290
El Salvador	9	587	15	1,992
France	(1)	22	10	580
Germany, West	4	1,070	4	1,483
Greece	1	248	1	195
Guatemala	3	307	11	1,906
Italy	20	1,085	20	1,158
Japan	(1)	407	(1)	222
New Zealand	12	729	(1)	50
Nicaragua	4	126	23	4,379
Panama	3	327	1	168
Sweden	23	814	119	6,534
Thailand	13	1,288	6	1,354
United Kingdom	22	838	(1)	89
Vietnam, South	130	14,714	57	7,164
Other	21	2,415	34	5,902
Total	375	34,084	474	53,476

[1] Less than ½ unit.

Table 15.—U.S. exports of elemental phosphorus, by country

Destination	1973		1974	
	Quantity (short tons)	Value (thousands)	Quantity (short tons)	Value (thousands)
Argentina	2,255	$1,095	1,402	$1,413
Australia	1,365	1,478	20	13
Belgium-Luxembourg	103	45	4	1
Brazil	106	46	35	15
Canada	--	--	161	70
Denmark	107	54	450	376
Egypt	--	--	110	220
Germany, West	426	206	260	189
India	62	38	64	152
Japan	940	404	6,990	3,341
Mexico	20,883	8,427	23,853	14,088
United Kingdom	367	445	119	62
Other	65	28	185	185
Total	26,679	12,256	33,653	20,075

Table 16.—U.S. imports for consumption of phosphate rock and phosphatic materials

(Thousand short tons and thousand dollars)

Fertilizer	1973		1974	
	Quantity	Value	Quantity	Value
Phosphates, crude and apatite[1]	65	1,288	182	8,999
Phosphatic fertilizers and fertilizer materials	[r] 182	[r] 11,889	202	32,512
Ammonium phosphates, used as fertilizers	393	27,290	344	40,509
Bone ash, bone dust, bone meal and bones ground, crude or steamed	13	1,374	6	664
Dicalcium phosphate	3	175	7	1,343
Basic slag	--	--	([2])	1
Manures including guano	([2])	3	([2])	15
Phosphorus	1	745	1	1,214
Phosphoric acid	([2])	49	2	619

[r] Revised.

[1] Adjusted by the Bureau of Mines.

[2] Less than ½ unit.

WORLD REVIEW

Phosphate rock deposits throughout the world were intensively evaluated for greater production, and exploration for new sources of supply was also intensified. The stimulus was the threefold to fourfold increase in price that was announced near the end of 1973. Significant developments in the world were as follows:

Australia.—The rapid increase in world phosphate rock prices encouraged Queensland Phosphate Pty. Ltd., a subsidiary of Broken Hill South Ltd., to prepare for production, early in 1975, the Duchess phosphate rock deposit rather than proceed to develop the Lady Annie property which could not produce before 1977. Production from Duchess will start at a rate of 20,000 tons per month and is expected to reach 1 million tons per year in 1976. A 25 mile rail line will connect the mine with the port of Townsville. Duchess and a nearby deposit, the Ardmore, contain 1.4 billion tons of phosphate rock of which 40 million tons is 31% P_2O_5, a direct shipping grade. A crushing, screening, and washing plant is under construction.

Brazil.—Serrana de Mineração and the Cimento Itaú group have founded Araxá S.A. Fertilizantes to mine apatite at Araxá, Minas Gerais. The investment was approved by the Industrial Development Council of the Ministry of Industry and Commerce. By 1976, Araxá S.A. is expected to produce at a rate of 628,000 short tons per year.

India.—About 430 tons of phosphate rock per day was mined from the Jhamar Kotra deposits in Rajasthan near Udaipur. The proven reserves are 37 million tons which will permit extraction at a proposed rate of 750,000 tons per year. The production from the Jhamar Kotra mine is used domestically. The meter gage railroad in Rajasthan, incompatible with broad gage lines, and the shortage of rail cars were major obstacles to mine expansion plans.

Israel.—Negev Phosphates Ltd., a subsidiary of the state-owned Israel Chemicals Ltd., plans to increase production at mines in the Negev Desert from a current level of about 750,000 tons per year to 2.8 million tons per year in 1977. Reserves are estimated to exceed 100 million tons.[8]

Jordan.—The Jordan Phosphate Mines Co. plans to triple production of phosphate rock by 1976. If the schedule is accomplished, Jordan will produce 5.4 million tons in 1976, of which more than 50% will be a high-grade (73%–75% BPL) product. Confirmed reserves are of the order of 300 million tons and the resource is 1 billion tons.[9]

Mexico.—Mexico's National Patrimony Ministry announced the discovery of phosphate rock deposits in the Baja California peninsula. Reserves of 3 billion tons were specified.

Morocco.—Under a trade agreement between Morocco and the U.S.S.R., the U.S.S.R. has agreed to supply specialists and equipment to develop a phosphate complex in southern Morocco. The long-term arrangement is designed to have Morocco furnish 5 million tons per year of phosphate rock between 1980 and 1990 and 10 million tons per year after 1990. The length of the agreement was reported to be 30 years. The phosphate mine is in the Meskala region, east of the port of Essaouira. The first estimate made of reserves in this area was 8 billion tons in the top 63 feet of the deposit. The U.S.S.R. will ship to Morocco, between the years 1974 to 1990, sulfur, ammonia, urea, and crude oil. The schedule of shipments for each commodity was not published. Plans to open mines at Benguerir in 1977 to eventually produce 11 million tons per year, and at Sidi Hajjaj in 1980 to develop a production of 11 million tons per year are well advanced. By 1977 the Khouribga mines will be producing at a level of about 22 million tons per year. Production at Youssoufia will remain at 6 to 7 million tons per year. By 1985, Morocco's production, including that planned from the Meskala, could be of the order of 55 million tons per year if all of these plans materialize.

New Zealand.—A large underwater deposit of phosphate nodules between Chatham Island and the Banks Peninsula is being explored as a possible source of phosphates for New Zealand. The phosphorites were reported to be at depths of 1,000 feet or more and the recoverable reserve was estimated to be of the order of 70 million tons.[10]

Pakistan.—The Hazara deposits, that occur in several locations near the city of Abbottabad in the Northwest Frontier Province, are being explored but little is known about the total reserves. At one deposit, the Kabul, considerable development work was completed. The deposit was explored along 2,500 feet of outcrop. The mineralized zone is 10 to 12 feet in thickness, averaging 28% to 32% P_2O_5. The area is badly faulted and folded. The reserve of the Kabul deposit may reach 3 million tons. The rock does not appear to react readily with sulfuric acid.

Peru.—Minero Peru started a brines and phosphate rock pilot plant. The plant was designed to produce 50 tons per day. The commercial plant design is for about 3 million tons per year and is scheduled to start production in 1976 at 800,000 tons per year.

Senegal.—The Senegalese Government announced that it will increase its holding in Compagnie Sénégalaise des Phosphates de Taiba to 50%. The Taiba Company was owned 27.28% by Bureau de Recherches Géologiques et Minières (BRGM), 23.87% by International Minerals & Chemicals Corp. (IMC), 14.3% by Compagnie Financiére Pour l'Outremer (Cofimer) of France, 10.41% by Cie. Central de Cooperation Economique (CCCE), 2.48% by Comiphos, 9.05% by OPCIA, 5.21% by Rhône-Progil, 3.76% by Auxom, 0.46% by OPFIA, and 3.05% by the Senegalese Government.[11]

South Africa, Republic of.—The flotation plant of Phosphate Development Corp. Ltd., treating tailings from the Palabora Mine, is to be expanded. An additional

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[8] Chemical Week. V. 15, No. 8, Aug. 21, 1974, p. 9.

[9] Fertilizer International. No. 66, December 1974, p. 8.

[10] Engineering and Mining Journal. V. 175, No. 5, May 1974, p. 9.

[11] Industrial Minerals. No. 82, July 1974, pp. 35–36.

900,000 tons per year of concentrates is projected from the expansion.[12]

Spanish Sahara.—The conveyor belt that carries phosphate rock from the mines at Bu Craa to the port of El Aauin was sabotaged by guerillas during the year, interrupting this part of the operation for extended periods. Production was about 2.6 million tons, a substantial increase over production of less than 1 million tons in 1973.

Togo.—In January, Togo raised its holding interest from 35% to 51% in Compagnie Togolaise des Mines du Bénin (Cotomib). In February Cotomib was nationalized. The company was partially owned by W. R. Grace & Co. of the United States and six French firms.[13]

Tunisia.—The Government of Tunisia is arranging financing from the World Bank to modernize old mines and develop new mines. The older mines near Gafsa are Metlaoui, Redeyef, Monlares, and M'dila. Under the 4-year plan of 1973–76, three new mines at M'rata, Sehib, and Kef Sehefera are to be opened by 1976.

U.S.S.R.—A recent U.S. Department of Agriculture study of U.S.S.R. fertilizer consumption indicated that phosphate application rates per hectare of sown area are about 30% of the rate in the United States. Although the U.S.S.R. is the second largest producer of phosphate rock in the world, with an output of 25 million tons in 1974, plans to import more phosphates to reduce the phosphorus deficiency on arable land are underway. The agreement between the U.S.S.R. and Occidental Petroleum Corp. to barter ammonia, urea, and potash for superphosphoric acid starting in 1978, and the negotiations with Morocco to secure phosphate rock for the longer term, are examples of progress to assure future phosphorus supplies.[14]

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[12] Mining Magazine. V. 130, No. 2, February 1974, p. 125.

[13] Industrial Minerals. Phosphate Company Nationalised. No. 78, March 1974, p. 31.

[14] Industrial Minerals. Fertiliser Aims. No. 82, July 1974, p. 36.

Table 17.—Phosphate rock: World production by country
(Thousand short tons)

Country [1]	1972	1973	1974 [p]
North America:			
United States	40,831	42,137	45,686
Mexico	69	79	214
Netherlands Antilles	123	102	118
South America:			
Argentina (guano)	([2])	1	[e] 1
Brazil	[r] 331	315	244
Chile (guano)	17	14	21
Colombia	7	11	11
Peru [e]	25	25	25
Venezuela	33	33	156
Europe:			
France (phosphatic chalk)	20	32	22
Germany, West	[r] 79	102	94
U.S.S.R. [e] [3]	21,750	23,400	24,800
Africa:			
Algeria	[r] 603	675	812
Egypt, Arab Republic of	620	610	606
Morocco	[r] 16,650	18,824	21,739
Rhodesia, Southern	121	165	143
Senegal:			
Aluminum phosphate	183	241	447
Calcium phosphate	1,378	1,690	1,623
Seychelles Islands (guano) [e]	8	8	8
South Africa, Republic of	1,380	1,505	1,491
Spanish Sahara	165	768	2,630
Togo	2,126	2,527	2,835
Tunisia	3,734	3,828	4,215
Uganda (apatite)	[r] 16	17	17
Asia:			
China, People's Republic of [e]	2,900	3,300	3,300
Christmas Island (Indian Ocean)	1,269	1,695	1,945
India:			
Apatite	13	11	[e] 11
Phosphate rock	239	149	129
Israel	[r] 1,033	860	1,048
Jordan	765	1,219	1,758
Korea, North (apatite) [e]	330	400	440
Philippines:			
Guano	2	([2])	[e] 1
Phosphate rock	3	13	[e] 13
Syrian Arab Republic	124	165	551
Vietnam, North [e]	310	550	1,300
Oceania:			
Australia	1	6	6
Nauru Island	1,474	2,561	2,522
Ocean Island	555	820	619
Total	[r] 99,287	[r] 108,858	121,601

[e] Estimate. [p] Preliminary. [r] Revised.

[1] In addition to the countries listed, Belgium, Indonesia, and Tanzania produce phosphate rock. and South West Africa produces guano, but information is inadequate to make reliable estimates of output levels.

[2] Less than ½ unit.

[3] Estimate by International Superphosphate Manufacturers' Association, on the basis of marketable product averaging 34.8% P_2O_5; differs with data reported in the U.S.S.R. chapter of Volume III of the Minerals Yearbook, which are reported in terms of two products of differing grade.

TECHNOLOGY

The Albany Metallurgy Research Center of the Federal Bureau of Mines, Albany, Oreg., designed, assembled, and tested a phosphoric acid miniplant to demonstrate the production of phosphoric acid by direct sulfuric acid digestion of Florida land-pebble matrix. Initial tests were made with matrix from three Florida mines. Recovery of P_2O_5 exceeded 90% and gypsum crystal size was similar to that obtained in bench-scale circuit tests. The waste product was sandy and easily dewatered. Except for higher aluminum content, chemical quality of filter acid was comparable to industrial grade acid. Sulfuric acid consumption was about 8% higher processing matrix compared with processing concentrates. Studies to further investigate gypsum crystal growth and filtration rates will continue.

The Albany Metallurgy Research Center also initiated a program to study and develop methods to remove iron, aluminum, magnesium, silicon, fluorine, and other impurities from wet process phosphoric acid. Methods of accelerating sludge formation and removal were attempted and studies of the potential of ion exchange resins to extract impurities were started.

Studies were continuing at the Albany Metallurgy Research Center to develop new techniques or modify existing phosphate rock acidulation processes to increase fluorine recovery from phosphate rock, develop methods to utilize low-grade calcareous fluorspars to recover fluorine, and use waste byproducts generated by industry to recover fluorine.

The Tuscaloosa Metallurgy Research Laboratory, Federal Bureau of Mines, Tuscaloosa, Ala., continued programs to study and develop techniques to dewater phosphate slimes. The studies include gel formation in phosphate slimes, development of the moving screen method to dewater slimes, investigations of the properties of slimes, electrical conductivity measurements on the effects of reagents, scanning electron microscope work to understand the behavior of fine-particle suspensions, and development of methods to quantify the mineral content of phosphate slime wastes. In addition, the Tuscaloosa Metallurgy Research Laboratory continued to characterize samples of phosphate bearing Hawthorn Formation limestone and study beneficiation systems. A typical sample from the Hawthorn Formation may contain 5% P_2O_5. After sizing to 14 by 400 mesh, calcining, water quenching, washing, dewatering, stage grinding through 150 mesh, conditioning and flotation, a 25% P_2O_5 concentrate was produced. The P_2O_5 recovery was about one-third of the total in the sample.

The first commercial plant using an ion exchange technique, developed by Lancy Laboratories, Zelienople, Pa., to recover and regenerate concentrated phosphoric acid from waste liquor was constructed for Douglas & Lomason Co., Cleveland, Miss. At this aluminum finishing plant, the process will handle 1,500 gallons per day of waste liquor from the rinse section of the bright finishing plant. The liquor contains 22% P_2O_5. The concentrated acid will analyze about 54% P_2O_5 and be recycled to the bright finishing bath.

A test plant at Seneca Falls, N.Y., has shown that over 90% of the phosphates in municipal sewage can be removed by a biological process at about one-tenth the cost of alternative chemical methods. The PhoStrip process of Biospherics, Inc., Rockville, Md., reduced phosphate levels from 6.3 to 0.55 parts per million at a cost of about 0.2 cents per 1,000 gallons. Activated sludge bacteria were cycled through the aeration (bubbling in air) section with a pickup of phosphates and followed by an anaerobic treatment (holding in tank). The released phosphates were precipitated by chemical action.

Wet-grinding phosphate rock was proposed by Davy Powergas Inc. to save drying costs, grinding equipment, power consumption, and obtain a significant reduction in dust loadings. The process would utilize a Société de Prayon, Belgian ball mill.

Friedrich Uhde GmbH, Dortmund, West Germany, developed a process to concentrate phosphoric acid. It operates by lowering the partial pressure of the moisture over the acid with a vapor which is immiscible with water and aqueous phosphoric acid. Gasoline was recommended as an inexpensive stripping agent vapor that, flowing countercurrent in a column, adsorbs water and fluorine compounds from the acid. This mixture of water, vapor, and fluorine is condensed before entering the separator. The concentrated phosphoric acid is cooled after leaving the column.[15]

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[15] Phosphorus & Potassium. No. 74, November–December 1974, p. 42.

Platinum-Group Metals

By W. C. Butterman [1]

World mine production of platinum-group metals increased nearly 10% in 1974 to 5.8 million troy ounces. Most of the increment came from the Republic of South Africa, which supplied large amounts of metal to the United States and Japanese automobile manufacturers for use as emissions control catalysts. Ninety-nine percent of the world's supply of new metal was mined in three countries—the Republic of South Africa, the U.S.S.R., and Canada. Two of the metals, rhodium and iridium, were in short supply during the first 6 to 9 months of the year. Demand for the platinum-group metals remained high through the first half of 1974 but dropped in the second half as economic recession spread through the industrialized countries. Prices of platinum, palladium, rhodium, and iridium rose sharply during the year.

In the United States, mine production declined 37% to about 13,000 ounces, an amount that satisfied less than 1% of domestic demand. U.S. refinery production, including both toll and nontoll metal and derived in 1974 almost entirely from secondary materials, increased 8% to 1.4 million ounces. Imports were up 29% to 3.2 million ounces, and exports rose 33% to 800,000 ounces. Sales of platinum and palladium to the automotive industry for use in emission control devices were estimated at 500,000 ounces. Sales of platinum-group metals to other industries for traditional uses dropped 19% to 1.5 million ounces. Industry stocks rose 10% to 1.1 million ounces.

Table 1.—Salient platinum-group metals [1] statistics

(Troy ounces)

	1970	1971	1972	1973	1974
United States:					
Mine production [2]	17,316	18,029	17,112	19,980	12,657
Value	$1,429,521	$1,359,675	$1,267,298	$2,103,704	$1,932,203
Refinery production:					
New metal	19,822	21,184	15,380	19,916	13,234
Secondary metal	350,176	278,175	255,641	265,901	325,216
Toll-refined new and secondary	1,721,870	1,452,838	1,361,623	1,039,189	1,088,022
Total refined metal	2,091,868	1,752,197	1,632,644	1,325,006	1,426,472
Exports (except manufactures)	413,766	404,610	538,994	627,526	835,754
Imports for consumption	[r] 1,531,807	[r] 1,388,043	[r] 1,892,184	2,504,181	3,240,605
Stocks Dec. 31: Refiner, importer, dealer	710,024	796,791	930,853	1,033,124	1,137,377
Consumption	1,331,152	1,261,312	1,562,245	[r] 1,833,901	1,981,010
World: Production	4,238,956	4,084,110	4,269,990	5,239,781	5,759,822

[r] Revised.

[1] The platinum group comprises six metals: Platinum, palladium, iridium, osmium, rhodium, and ruthenium.

[2] Recovered from platinum placers and as byproducts, largely from domestic copper ores.

Legislation and Government Programs.—U.S. Government inventories of platinum, palladium, and iridium remained unchanged in 1974. All three metals were substantially in excess of stockpile objectives established in 1973, but there was no

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[1] Physical scientist, Division of Nonferrous Metals.

Congressional authorization for disposal of the excess metal. Near the end of the second quarter, the President signed a bill that retained the Environmental Protection Agency (EPA) 1975 "interim" automobile emission standards for another year through model year 1976 and authorized the agency to extend them through model year 1977, if desirable. In early 1975, EPA scheduled hearings on automotive emissions technology and its effects on fuel economy and public health.

Table 2.—U.S. Government inventory of platinum-group metals, December 31, 1974
(Troy ounces)

	Platinum	Palladium	Iridium
National stockpile	[1] 402,646	[2] 507,314	[3] 17,002
Supplemental stockpile	49,999	747,680	--
Total	452,645	1,254,994	17,002
Objective	187,500	328,500	1,800

[1] Includes 2,566 troy ounces nonstockpile-grade material.
[2] Includes 2,204 troy ounces nonstockpile-grade material.
[3] Includes 12 troy ounces nonstockpile-grade material.

DOMESTIC PRODUCTION

Domestic mine production of platinum-group metals declined 37% in 1974 to 12,657 ounces as production from an Alaskan placer deposit and byproduct output at U.S. copper refineries fell markedly. The placer deposit at Goodnews Bay, Alaska, was the only domestic deposit mined primarily for platinum-group metals.

U.S. refinery production of platinum-group metals, including both primary and secondary metal and including toll-refined, rose 8% to 1.4 million ounces. Refinery production of new or primary platinum-group metals fell 43% in 1974 as contracts for refining of foreign concentrates expired. About 60% of all primary metal was refined on a toll basis. The primary metal was derived from crude platinum and from anode slimes produced in the electrolytic refining of nickel and copper. These materials came from Alaska, the copper deposits of the Western United States, and from Canada, Norway, and the United Kingdom.

The amount of secondary metal refined on a nontoll basis increased 22% in 1974, and the output of toll-refined metal, which is typically 3 to 5 times larger, increased 7%. Thus, overall secondary metal production increased 10%.

Table 3.—Platinum-group metals refined in the United States

(Troy ounces)

Year	Platinum	Palladium	Iridium	Osmium	Rhodium	Ruthenium	Total
PRIMARY METAL							
Nontoll-refined:							
1970	8,036	10,322	1,261	129	64	10	19,822
1971	10,198	10,237	498	154	83	14	21,184
1972	3,708	10,836	594	173	62	7	15,380
1973	5,560	13,121	957	176	88	14	19,916
1974	4,103	8,634	381	72	38	6	13,234
Toll-refined:							
1970	183,264	74,953	3,065	155	8,885	13	270,335
1971	156,599	66,467	2,491	161	8,118	14	233,850
1972	54,773	23,752	1,751	111	3,354	478	84,219
1973	32,883	r 3,972	1,158	102	r 381	r 70	r 38,566
1974	16,293	2,784	742	96	185	7	20,107
SECONDARY METAL							
Nontoll-refined:							
1970	118,298	208,555	1,927	121	13,394	7,881	350,176
1971	103,429	161,099	2,186	352	8,837	2,272	278,175
1972	75,942	162,718	4,393	149	11,390	1,049	255,641
1973	94,884	150,019	6,785	20	11,561	2,632	265,901
1974	95,999	213,416	3,494	6	11,127	1,174	325,216
Toll-refined:							
1970	896,472	494,758	2,594	803	47,861	9,047	1,451,535
1971	625,649	527,375	9,572	4,008	43,173	9,211	1,218,988
1972	787,697	431,248	7,717	1,520	44,065	5,157	1,277,404
1973 r	581,005	373,396	3,395	1,292	36,865	4,670	1,000,623
1974	654,156	365,779	3,465	1,447	36,196	6,872	1,067,915
1974 TOTALS							
Total primary refined	20,396	11,418	1,123	168	223	13	33,341
Total secondary refined	750,155	579,195	6,959	1,453	47,323	8,046	1,393,131
Grand total refined	770,551	590,613	8,082	1,621	47,546	8,059	1,426,472

r Revised.

CONSUMPTION AND USES

Sales of platinum-group metals, exclusive of automotive emission catalysts, decreased 19% in 1974 to 1.5 million ounces. Sales of platinum and palladium declined 10% and 27%, respectively. Sales of osmium and ruthenium countered the trend, rising 6% and 14%, respectively. Consumption of platinum and palladium in automotive emission catalysts was estimated at 300,000 ounces, with sales to the industry estimated at 500,000 ounces. Total sales of platinum-group metals to U.S. industry in 1974 were estimated at 1.98 million ounces, an 8% increase over 1973 sales. The electrical industry, for many years the largest purchaser of platinum-group metals, accounted for 28% of total sales, followed by the automotive industry (25%) and the chemical industry 22%).

Platinum sales to the automotive industry were estimated at 350,000 ounces. Platinum sales to other industries were 594,000 ounces, down 10% from the 1973 sales level. With the advent of automotive emission catalysts, the distribution of platinum among consuming industries changed in 1974. The automotive industry in a single year became the largest purchaser at 37% of total sales, followed by the chemical industry (23%), the petroleum refining industry (15%), and the electrical industry (10%). Platinum sales to the chemical, electrical, and dental-medical industries dropped 10%, 16%, 9%, respectively. Sales for miscellaneous uses showed a much steeper decline, 69%. Sales to the petroleum refining, glass, and jewelry industries increased by 13%, 3%, and 2%, respectively.

Palladium sales to the automotive industry were estimated at 150,000 ounces. Palladium sales to other industries were 736,000 ounces, 27% below the 1973 sales level. Of total sales, the electrical industry took 44%; the chemical industry, 18%; the automotive industry, 17%; and the dental-medical industry, 14%. Palladium sales to the petroleum refining industry increased about fourfold, and sales to the glass industry rose sixfold, but sales for other uses fell, as follows: Chemical, 37%; electrical, 26%; dental-medical, 8%; jewelry, 6%; and miscellaneous, 81%.

Sales of iridium decreased 26%, to about 23,000 ounces, of which 44% went to the petroleum refining industry, 32% to the chemical industry, and 12% to the electrical industry. Sales to all the principal consuming industries were below 1973 levels.

Sales of osmium increased 6% to 1,723 ounces, essentially all of which went to the chemical and dental-medical industries.

Rhodium sales dropped 16% in 1974, to about 62,000 ounces, distributed among the principal consuming industries, thus: Chemical 38%, electrical 25%, jewelry 17%, and glass 12%. The chemical industry purchased about the same amount of rhodium as in 1973, and sales to the electrical industry were up 18%. However, sales to the glass and jewelry industries were 55% and 16%, respectively, below 1973 levels.

Sales of ruthenium increased 14% to about 65,000 ounces; two-thirds went to the electrical industry, and most of the remainder, to the chemical industry. A fourfold increase in electrical industry requirements in 1974, and a halving of chemical industry requirements, reversed the distribution pattern of the past decade.

The uses for platinum-group metals in modern industry are related to their extraordinary catalytic properties, refractoriness, and resistance to chemical corrosion over a wide temperature range. The pattern of industrial applications of platinum and palladium changed significantly in 1974 with the introduction of catalytic exhaust converters on automobiles. These patterns are shown in figure 1. Catalyst manufacturers began delivering commercial quantities of emissions catalysts to automotive companies in the second quarter of the year. Typically, each vehicle required between one-twentieth and one-tenth troy ounce of platinum/palladium, the two metals being present roughly in a 2-to-1 ratio. However, one automotive company used unalloyed platinum in a catalyst for some of its vehicles. More than 90% of domestically produced automobiles were equipped with catalytic converters, as were a somewhat smaller percentage of imported automobiles.

The consumption of palladium in the U.S. electrical industry was significantly reduced in 1974, when the largest manufacturer of telephone exchange equipment began using a 60 palladium/40 silver alloy for relay contacts in place of unalloyed palladium.

Table 4.—Platinum-group metals [1] sold to consuming industries in the United States

(Troy ounces)

Year and industry	Platinum	Palladium	Iridium	Osmium	Rhodium	Ruthenium	Total
1970	509,011	739,348	10,905	1,707	48,897	21,289	1,331,152
1971	426,684	760,106	15,512	2,126	34,366	22,518	1,261,312
1972	545,299	876,024	37,754	2,397	46,095	54,676	1,562,245
1973:							
Chemical	238,974	259,959	10,635	1,003	23,772	38,713	573,056
Petroleum	123,649	3,761	13,385	--	3,057	92	143,944
Glass	72,543	1,439	51	--	16,689	82	90,804
Electrical [r]	117,352	524,056	3,516	--	13,187	10,341	668,452
Dental and medical	27,887	135,060	145	626	297	164	164,179
Jewelry and decorative	22,433	23,052	1,191	--	[r] 12,526	2,317	[r] 61,519
Miscellaneous	55,695	65,157	1,753	--	3,987	5,355	131,947
Total [r]	658,533	1,012,484	30,676	1,629	73,515	57,064	1,833,901
1974:							
Automotive [e]	350,000	150,000	--	--	--	--	500,000
Chemical	215,663	163,205	7,334	981	23,328	16,305	426,816
Petroleum	139,519	14,877	9,970	--	1,239	--	165,605
Glass	74,398	9,549	353	--	7,464	351	92,115
Electrical	98,608	390,237	2,840	55	15,538	43,916	551,194
Dental and medical	25,518	124,074	325	687	373	236	151,208
Jewelry and decorative	22,968	21,701	884	--	10,460	2,240	58,253
Miscellaneous	17,020	12,420	1,072	--	3,200	2,107	35,819
Total	943,689	886,068	22,778	1,723	61,602	65,155	1,981,010

[e] Estimate. [r] Revised.

[1] Comprises primary and nontoll-refined secondary metals.

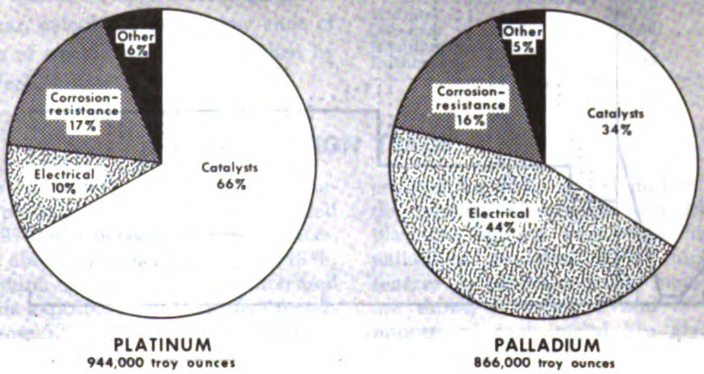

Figure 1.—Uses of platinum and palladium in 1974.

STOCKS

Stocks of platinum-group metals held by refiners, importers, and dealers increased 10% in 1974. Palladium stocks declined 1%, but stocks of the other metals increased as follows: Platinum, 23%; iridium, 17%; osmium, 166%; rhodium, 4%; and ruthenium, 10%. In addition to these stocks, there were Government stockpiles of platinum, palladium, and iridium. (The Bureau of Mines does not receive inventory data from end users of platinum-group metals; it should be noted that some industries, such as the automotive industry, may hold substantial amounts of refined metal in inventory, which are not included in Bureau stock figures.)

Table 5.—Refiner, importer, and dealer stocks of platinum-group metals in the United States, December 31 [1]

(Troy ounces)

Year	Platinum	Palladium	Iridium	Osmium	Rhodium	Ruthenium	Total
1970	291,544	332,726	13,366	1,868	47,767	22,753	710,024
1971	385,828	316,126	16,434	604	51,529	26,270	796,791
1972	426,611	405,793	14,987	82	56,967	26,413	930,853
1973	446,522	493,078	14,813	327	51,504	26,880	1,033,124
1974	549,603	486,375	17,376	869	53,533	29,621	1,137,377

[1] Includes metal in depositories of the New York Mercantile Exchange; on Dec. 27, 1974, this comprised 217,500 ounces of platinum and 12,800 ounces of palladium.

PRICES

The prices of osmium and ruthenium remained unchanged in 1974, but the prices of the other four metals rose sharply. The producers' prices, per troy ounce, increased from the beginning of the year as follows: Platinum, $158 to $190 by midyear; palladium, $84 to $150 by May; rhodium, $270 to $350 by May; and iridium, $285 to $500 by October. Dealers' prices for palladium and platinum remained above the producers' prices until the second and third quarters, respectively, then dropped below the producers' prices for the remainder of the year. Rhodium

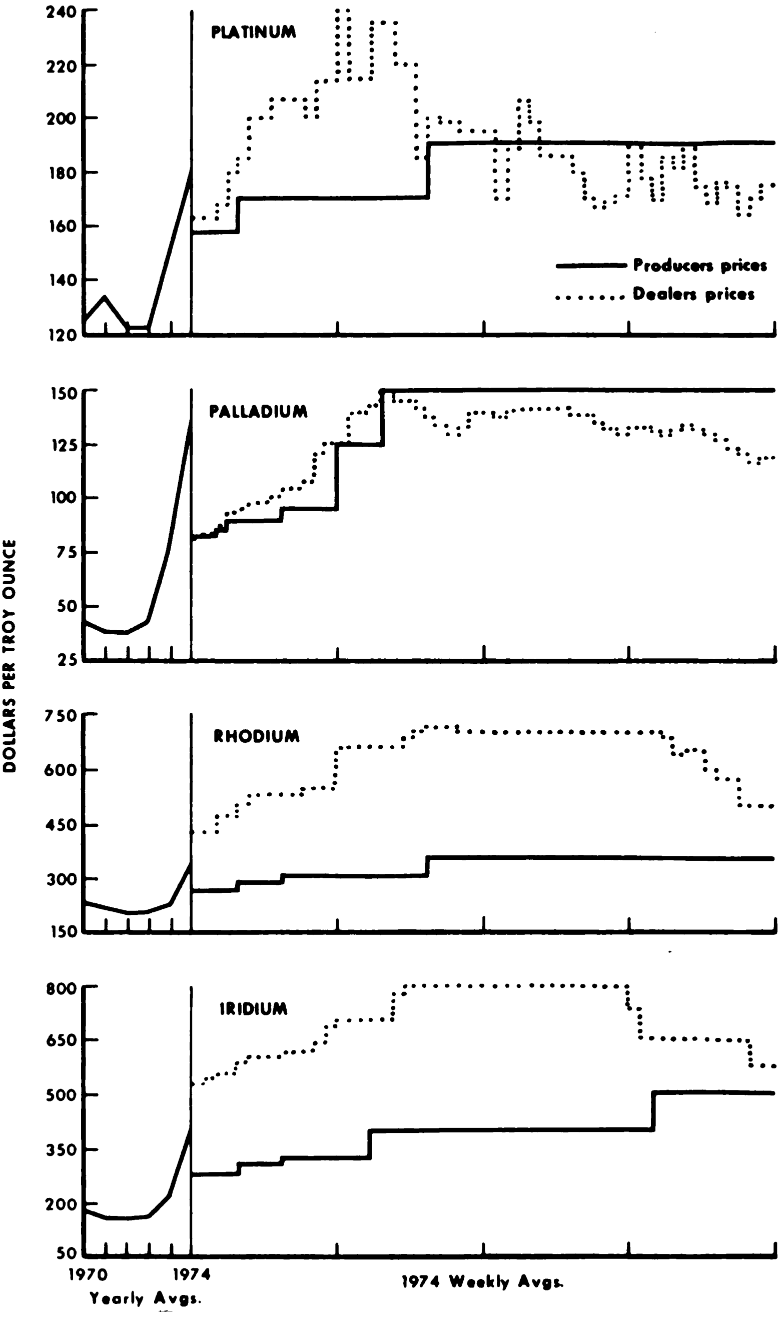

Figure 2.—Prices of four platinum-group metals.

and iridium were in short supply, and dealers' prices were high all year, about double the producers' price in the second and third quarters (fig. 2). Average prices for the year, calculated at the low ends of the ranges of weekly averages published by Metals Week, follow:

	Producer (per troy ounce)	Dealer (per troy ounce)
Platinum	$180.85	$192.37
Palladium	133.22	126.25
Iridium	390.77	699.77
Osmium	200.00	140.00
Rhodium	328.84	627.58
Ruthenium	60.00	54.73

FOREIGN TRADE

Exports of unwrought and semimanufactured platinum-group metals increased 33% in 1974, amounting to 835,754 ounces, of which about 401,000 ounces, or 48%, was platinum. Platinum exports increased 18%, while exports of the other five metals together rose 52%. The value of platinum-group metals exports increased 51% to $117 million. Three-fourths of the platinum-group metals went to four countries: Japan, 30%; West Germany, 22%; the United Kingdom, 12%; and Switzerland, 11%. Platinum alone accounted for most of the metal going to Japan and the United Kingdom but was a minor part of the total platinum-group metals going to Switzerland and West Germany.

Imports of platinum-group metals rose 29% in quantity, to 3.2 million ounces, and increased 86% in value to $503 million. Platinum and palladium each accounted for 46%, or 1.5 million ounces of the imports. Compared with 1973 levels, platinum imports were 40% higher, and palladium imports, 21% higher. The sources of platinum-group metals imports are shown in tables 7 and 8. Estimated imports of each metal are given in the following tabulation. (These figures combine the amounts explicitly stated in table 7 with estimates of the metal content of the five composite categories in that table.)

	Thousand troy ounces
Platinum	1,490
Palladium	1,498
Iridium	40
Osmium	7
Rhodium	121
Ruthenium	85
Total	3,241

Table 6.—U.S. exports of platinum-group metals, by country

Year and destination	Platinum-group metals				Platinum, unworked or partly worked				Platinum-group metals, except platinum, unworked or partly worked				Total	
	Ores and concentrates		Waste, scrap and sweepings		Not rolled		Rolled		Not rolled		Rolled			
	Quantity (troy ounces)	Value (thousands)	Quantity (troy ounces)	Value (thousands)	Quantity (troy ounces)	Value (thousands)	Quantity (troy ounces)	Value (thousands)	Quantity (troy ounces)	Value (thousands)	Quantity (troy ounces)	Value (thousands)	Quantity (troy ounces)	Value (thousands)
1973:														
Australia	--	--	--	--	2,881	$443	--	--	6,025	$500	--	--	8,906	$943
Belgium-Luxembourg	--	--	69,381	$5,297	110	31	--	--	103	17	--	--	69,594	5,345
Brazil	360	$14	--	--	4,342	595	--	--	711	37	644	$53	6,057	699
Canada	--	--	125	6	1,698	342	538	$108	16,867	1,015	1,130	51	20,358	1,522
China, People's Republic of	--	--	--	--	17,792	2,951	--	--	331	19	--	--	18,123	2,970
Germany, West	2,996	267	15,416	1,127	43,833	7,048	17	3	38,373	3,055	3,245	288	103,880	11,788
Israel	--	--	--	--	--	--	--	--	304	12	3,674	111	3,978	123
Japan	--	--	323	52	218,895	34,170	25,336	3,954	50,900	5,721	15,486	1,346	310,940	45,243
Mexico	--	--	--	--	200	41	46	9	5,034	367	47	3	5,327	420
Netherlands	--	--	50	19	5,967	936	--	--	10,495	1,452	3,157	227	19,669	2,634
Spain	821	204	--	--	--	--	--	--	1,125	87	--	--	1,946	291
Switzerland	87	29	32	9	1,355	193	216	70	2,416	162	3,713	295	7,819	758
United Kingdom	455	65	18,469	2,487	326	67	4	1	8,613	428	34	2	27,901	3,050
Other	118	5	2,230	72	4,213	629	820	135	14,952	962	695	36	23,028	1,839
Total	4,837	584	106,026	9,069	301,612	47,446	26,977	4,280	156,249	13,834	31,825	2,412	627,526	77,625
1974:														
Belgium-Luxembourg	80	16	49,620	6,650	140	41	--	--	24	3	--	--	49,864	6,710
Canada	611	71	--	--	1,847	278	1,922	365	25,764	3,186	522	30	30,666	3,930
France	--	--	--	--	137	30	7	2	6,975	701	2,144	264	9,263	997
Germany, West	38,457	2,067	21,916	2,368	33,101	7,195	--	--	79,473	9,889	8,606	1,194	181,553	22,713
Israel	--	--	--	--	--	--	--	--	72	6	12,927	286	12,999	292
Japan	--	--	--	--	193,251	35,869	10,586	1,940	39,466	5,540	4,129	720	247,432	44,069
Netherlands	600	84	3,359	433	11,183	2,019	4	1	9,004	1,619	303	209	24,453	4,365
South Africa, Republic of	--	--	1,300	237	100	20	20	6	23,793	4,125	--	--	25,213	4,388
Switzerland	48	34	16	1	9,066	1,837	--	--	84,130	6,368	1,793	246	95,053	8,486
Taiwan	--	--	--	--	20	4	--	--	11,107	406	140	18	11,267	428
United Kingdom	5,612	456	16,084	2,414	65,144	11,870	222	30	16,827	1,428	24	1	103,913	16,199
Other	93	54	432	12	9,022	1,642	494	96	32,550	2,878	1,487	162	44,078	4,844
Total	45,501	2,782	92,727	12,115	323,011	60,805	13,255	2,440	329,185	36,149	32,075	3,130	835,754	117,421

Table 7.—U.S. imports for consumption of platinum-group metals, by country

Year and country	Unwrought (troy ounces)										
	Platinum grains and nuggets	Platinum sponge	Palladium	Iridium	Osmium	Osmiridium	Rhodium	Ruthenium	Unspecified combinations [1]	Platinum-group metals from precious metal ores	Sweepings, waste and scrap
1973:	19,146	499,271	496,065	19,701	557	3,600	72,856	67,218	239,427	r 150,172	84,534
1974:											
Belgium-Luxembourg	--	1,467	665	--	--	--	1,210	--	192	--	33,522
Canada	245	--	18,213	--	--	--	297	1,000	97	3	32,558
Colombia	10,500	--	--	--	--	--	--	--	2,400	--	5,465
France	--	--	1,905	--	--	--	--	--	--	--	--
Germany, West	--	1,766	4,882	964	--	--	1,275	186	1,895	--	752
Japan	29,274	644	27,168	--	--	--	6,567	--	85,068	--	7,232
Korea, Republic of	329	--	986	--	--	--	--	50	--	--	--
Mexico	--	15	8	--	--	--	8	--	147	--	25,102
Netherlands	--	--	--	2,700	--	--	96	547	985	--	1,128
Norway	2,850	7,151	6,540	--	--	--	--	350	--	37,924	190
South Africa, Republic of	6,847	578,013	295,349	8,212	1,500	--	8,622	10,714	30,900	--	3,562
Sweden	--	--	--	--	--	--	--	--	--	--	8,077
Switzerland	270	480	--	--	--	--	--	--	2,210	--	--
U.S.S.R	16,923	6,464	170,324	354	--	--	33,700	32	104,602	--	112
United Kingdom	3,916	286,943	61,974	16,750	400	4,393	45,283	51,055	--	50	826
Other	--	179	--	--	--	--	--	--	--	--	10,794
Total	71,154	883,122	588,014	28,980	1,900	4,393	97,058	63,884	228,496	37,977	129,320

Year and country	Semimanufactured (troy ounces)								Platinum-group metals in materials not elsewhere specified (troy ounces)	Total	
	Platinum	Palladium	Iridium	Osmium	Osmiridium	Rhodium	Ruthenium	Unspecified combinations [1]		Quantity (troy ounces)	Value (thousands)
1973:	155,715	658,240	3,805	--	--	20,355	--	1	r 13,518	2,504,181	$269,702
1974:											
Belgium-Luxembourg	--	--	--	--	--	--	--	--	--	37,056	5,410
Canada	1,883	742	45	--	25	170	--	--	2,694	57,972	8,164
Colombia	1,800	--	--	--	--	--	--	--	--	20,165	3,087
France	--	--	--	--	--	300	--	--	--	2,205	297
Germany, West	530	--	--	--	--	131	400	--	--	12,731	2,786
Japan	15,328	30,460	--	--	--	--	--	6,378	--	208,119	41,887
Korea, Republic of	--	--	--	--	--	--	--	--	--	1,365	210
Mexico	--	--	--	--	--	--	--	--	700	25,980	1,521
Netherlands	--	750	--	--	--	--	--	--	--	6,206	1,383
Norway	3,600	850	--	--	--	--	--	--	15,519	74,974	10,865
South Africa, Republic of	12,709	24,505	--	--	--	--	--	--	35,525	1,016,458	170,258
Sweden	--	--	--	--	--	--	--	--	--	8,077	779
Switzerland	4,919	1,502	--	--	--	--	--	--	--	9,381	1,743
U.S.S.R	85,193	593,019	--	--	--	946	--	652	--	1,012,321	134,199
United Kingdom	72,867	98,198	321	--	--	2	--	--	141,480	734,458	118,517
Other	526	47	--	--	--	--	--	--	1,591	13,137	1,591
Total	199,355	750,073	366	--	25	1,549	400	7,030	197,509	3,240,605	502,697

r Revised.

[1] Contains not less than 90% platinum by weight.

Table 8.—Imports of platinum-group metals, by source 1974
(Percent of total imports)

Source	Platinum	Palladium	Iridium	Osmium	Rhodium	Ruthenium	Total
South Africa, Republic of	44	22	23	32	9	16	31
U.S.S.R	14	51	4	--	30	1	31
United Kingdom	27	13	50	61	42	72	23
Japan	9	4	8	--	11	1	6
Other	6	10	15	7	8	10	9

WORLD REVIEW

World mine production of platinum-group metals rose 10% in 1974, to 5.8 million ounces, mainly as a result of continued expansion of capacity in the Republic of South Africa. The Republic of South Africa, the U.S.S.R., and Canada accounted for 99% of the output.

Mine production in the United States fell 37% to 12,657 ounces, which was less than 1% of industrial demand. The Johns-Manville Corp. continued exploration of the Stillwater complex in southern Montana. This assemblage of igneous rocks is believed to contain most of the U.S. resources of platinum-group metals. The results of field and laboratory tests to date suggest some possibility of future production from the area.

Placer mining in Colombia continued at the same level as in past years, yielding 27,000 ounces of platinum. Small, but significant amounts of platinum-group metals were produced as byproducts of copper and nickel refining in Japan and Finland.

Canada.—Canadian output of platinum-group metals remained about the same as in 1973. A buildup of platinum-group metals in the recovery circuits of the major producer kept production below the expected level. Platinum-group metals were byproducts of nickel-copper mining in Canada, and were produced from mines of the International Nickel Co. Inc. (INCO) and Falconbridge Nickel Mines, Ltd., in the Sudbury, Ontario, and Thompson, Manitoba, districts. A small amount came from the Manitoba properties of Dumbarton Mines Ltd. INCO's platinum-group metals-bearing concentrates were refined to metal in the United Kingdom, whereas Falconbridge's concentrates were refined in the United States after intermediate processing in Norway.

Sheridan Geophysics Ltd.[3] announced the discovery of a potentially important platinum-group metals deposit in northern Ontario at Lac des Iles, 50 miles northwest of Thunder Bay. Ore-grade platinum-group metals containing platinum and palladium in the ratio of 1 to 8 were found in two horizons that may be minable. Ore tonnages remained speculative at yearend, but exploration was being continued by Boston Bay Mines Ltd., a Sheridan Geophysics subsidiary.

South Africa, Republic of.—South Africa became the leading world producer of platinum-group metals in 1974, increasing output 20% to 2.8 million ounces. Worldwide, it accounted for nearly two-thirds of all platinum and one-fourth of the palladium mined. Except for some osmiridium recovered as a byproduct of gold mining, all of the platinum-group metals were mined as the principal products from mines in the Merensky Reef, Transvaal Province. The Reef is a very extensive and uniform formation that yields about 0.2 ounce of platinum-group metals per ton of ore, along with significant amounts of nickel and copper. South Africa is estimated to have more than two-thirds of the world's reserves of platinum-group metals. The four companies that mined platinum-group metals in 1974 are listed, with estimates of capacities and production, in the following tabulation:

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[3] The Northern Miner. Palladium Discovery in Northwest Ontario Attracts Interest. V. 60, No. 18, July 18, 1974, p. 27.

———. V. 60, No. 32, Oct. 24, 1974, pp. 1-15.

Mining Journal. Platinum Property Option for Texasgulf. V. 284, No. 7292, May 23, 1975, p. 403.

Company	Estimated 1974 yearend capacity, platinum-group metals (thousand ounces)	Estimated 1974 production, platinum-group metals (thousand ounces)
Rustenburg Platinum Mines Ltd	2,100	1,775
Impala Platinum Ltd	1,630	890
Western Platinum Ltd	150	145
Atok Platinum Mines Pty., Ltd	40	25

Production of at least two of these companies was limited somewhat by the shortage of underground labor during the year.

Expansion of the Wadeville platinum-group metals refinery, owned jointly by Rustenburg Mines and Johnson, Matthey & Co. Ltd., was completed in 1974. The enlarged facility, located near Johannesburg, had a capacity of more than 1.5 million ounces of platinum-group metals.[3] During the year, Rustenburg Mines purchased the Eland Platinum Mining Co., thus acquiring a 4-mile length that had separated two sections of the Amandelbult mine, under development by Rustenburg.[4] Late in the year, Rustenburg decided to stretch its capital expenditure program by 18 months and set a new production target of 1.63 million ounces of platinum per year, to be reached by the end of 1977.

By midyear, Impala Platinum Ltd. had expanded production capacity to 850,000 ounces of platinum per year and expected to reach 950,000 ounces by yearend.[5] At midyear, the company was producing at the rate of 600,000 ounces of platinum per year. Owing to general labor shortages, brief labor disputes in the mine itself, and a mud slide that closed one shaft temporarily, the rate failed to rise significantly during the remainder of the year.

A platinum-group metals refinery with a capacity of 150,000 ounces per year was completed in the first half of 1974 by Lonhro Ltd. This facility, located at Brakpan, on the east Rand near Rustenburg, was built to process concentrates from Western Platinum Ltd.; previously, these concentrates had been refined in Norway and the United States. Western Platinum produced 139,000 ounces of platinum-group metals in 1974 compared with 109,000 ounces in 1973.[6]

Atok Platinum Mines, Pty., Ltd., doubled its production rate in 1974, bringing it to about 48,000 ounces per year of platinum-group metals by early 1975. Atok's output was processed in successive steps by Western Platinum in South Africa, and Falconbridge Nickel Mines, Ltd., in Norway.

U.S.S.R.—The U.S.S.R. remained the leading world producer of palladium in 1974, even though it fell behind the Republic of South Africa in output of total platinum-group metals. An estimated 2.5 million ounces of platinum-group metals were extracted from nickel-copper deposits in the Norilsk-Talnakh region of northwestern Siberia, and from the Petsamo-Monchegorsk region of the Kola Peninsula. A small part of the output came from the old platinum placer deposits in the central Urals. Platinum and palladium comprised about 90% of the refined metal, and the palladium/platinum ratio was estimated between 2 to 1 and 3.5 to 1. Construction continued in the Norilsk-Talnakh area on what will reportedly be the world's largest mining-metallurgical complex. A major expansion in platinum-group metals output could accompany a large expansion in nonferrous metals production that the Soviets have planned for the next few years.

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[3] Platinum Metals Review. New Plants in Three Countries. V. 18, No. 3, July 1974, p. 103.

[4] Engineering and Mining Journal. V. 175, No. 8, August 1974, p. 116.

[5] Wall Street Journal. Impala Platinum Limited; Statement by the Chairman, I. T. Greig. V. 184, No. 66, Oct. 2, 1974, p. 66.

[6] Falconbridge Nickel Mines, Ltd. Annual Report, 1974. p. 42.

Table 9.—Platinum-group metals: World production by country [1]
(Troy ounces)

Country	1972	1973	1974 p
Australia:			
Palladium, metal content, from nickel ore e	r 1,400	1,500	1,750
Platinum, metal content, from nickel ore e		450	500
Canada: Platinum and other platinum-group metals	406,048	r 354,223	360,000
Colombia: Placer platinum	24,111	26,358	e 27,000
Ethiopia: Placer platinum	248	235	230
Finland: Platinum-group metals recovered from domestic copper ores by copper refineries e	650	725	650
Japan:			
Palladium from refineries	5,659	10,014	13,419
Platinum from refineries	4,240	6,827	5,451
Philippines:			
Palladium metal	4,810	4,205	2,315
Platinum metal	2,712	2,464	1,350
South Africa, Republic of:			
Platinum-group metals from platinum ores e	1,450,000	2,360,000	2,832,000
Osmiridium from gold ores (sales) e	3,000	2,800	2,500
U.S.S.R.: Placer platinum and platinum-group metals recovered from platinum-nickel-copper ores e	2,350,000	2,450,000	2,500,000
United States: Crude placer platinum and byproduct metals recovered largely from domestic gold and copper refining	17,112	19,980	12,657
Total	r 4,269,990	5,239,781	5,759,822

e Estimate. p Preliminary. r Revised.

[1] Excludes refined platinum production from Norway, which is derived from imported raw materials, chiefly (if not wholly) of Canadian origin, in order to avoid double counting.

TECHNOLOGY

Work continued in 1974 on various aspects of automotive emissions control technology. Tests of prototype 1975 model automobiles early in the year showed that in addition to oxidizing carbon monoxide and unburned hydrocarbons satisfactorily, the new platinum/palladium catalytic converters afforded a substantial increase in fuel economy.[7] On the other hand, there were preliminary indications that the oxidation catalysts increased the emission of sulfates and sulfur acids and it was feared that large numbers of converter-equipped cars from several years production might lead at times to dangerous concentrations of sulfates in the air near roadways.[8]

Looking ahead to the stricter regulations set for 1977 cars, which required nearly an eightfold reduction in nitrogen oxides emissions, automobile manufacturers were testing reduction converters. These devices were designed to be fitted close to the exhaust manifold, upstream from the oxidation converter. Ruthenium had been found to be an effective reducing catalyst but tended to volatilize under some engine operating conditions; substantial progress in stabilization of ruthenium catalysts was reported during the year.[9] Development continued on three-way converters, in which one catalyst performs both reducing and oxidizing functions, and catalyst manufacturers were confident of the efficacy of the three-way system. However, the system requires accurate, close-coupled control of the engine fuel/air mixture, and doubts were expressed in the automotive industry about the availability of control hardware suitable for mass production.

The future of platinum-group metal automotive catalysts appeared to depend not only on the further development of catalytic systems, but also on the progress of competing systems, such as base metal catalytic systems,[10] thermal converters,[11] the lean-burn engine, and the stratified charge engine,[12] all of which were under development.

Burgeoning research on supported homogeneous catalysts was reviewed during the year. These catalysts are of a type intermediate between heterogeneous and homogeneous catalysts and are made by attaching an active metal complex to an insoluble polymer support. Most of the complexes studied to date had been rhodium compounds, but the prospects of developing other platinum-group metal catalysts of this type were considered good.[13]

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[7] Metals Week. EPA Preliminary Tests Praise Converters. V. 45, No. 13, April 1, 1974, p. 6.

[8] Environmental Protection Agency. Automotive Sulfate Emissions. Federal Register, v. 39, No. 47, Mar. 8, 1974, p. 9229.

[9] Science and Technology. Catalytic Converters: An Answer From Technology. V. 8, No. 9, September 1974, pp. 771-868.

[10] American Metal Market. Gould's Nitrogen Oxide Control To Undergo Durability, Fuel Tests. V. 81, No. 216, Nov. 6, 1974, p. 11.

[11] ———. Ethyl Claims Its New Emission Control Uses Leaded Gas, Gives Fuel Economy. V. 81, No. 222, Nov. 14, 1974, p. 5.

[12] American Metal Market. Ghost of Wankel Hovers at Ford, But Engineers Turn to Other Designs. V. 81, No. 63, Apr. 1, 1974, p. 8.

Ruthenium could become important as a binder for high-temperature cemented carbides. Unlike the four cubic platinum-group metals, hexagonal ruthenium does not decompose refractory carbides. With titanium carbide, which is a significant cutting tool material, ruthenium forms a eutectic at 1,840° C, which is 400° C to 500° C above the eutectics formed with the conventional binders– nickel, cobalt, and iron.[14]

A new type of dispersion-strengthened platinum was described. Formed by the in situ oxidation of zirconium in a zirconium-platinum alloy containing only 600 ppm of zirconium, the new material has properties that are consistent and reproducible on a large scale. Good workability, a highly stable microstructure, good high-temperature strength, and creep resistance combine to make this material a potentially valuable alternative to conventional platinum alloys.[15]

Certain partially oxidized platinum complexes having semiconductive and metallic properties and anomalously high dielectric constants were described. These may be capable of development as one-dimensional metallic conductors and, ultimately, as high-temperature superconductors.[16]

It was reported that very pure metals of the lanthanide, actinide, and alkaline earth series can be prepared from their oxides by reduction in hydrogen in the presence of platinum-group metal catalysts. The platinum-group metals form intermetallic phases with the metals from the oxides; these compounds are decomposed at high temperatures to yield pure gaseous metals, which then condense to solid form.[17]

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[13] Platinum Metals Review. Supported Homogeneous Catalysts. V. 18, No. 2, April 1974, pp. 65-73.

[14] Platinum Metals Review. Ruthenium and Refractory Carbides. V. 18, No. 1, January 1974, pp. 27-28.

———. Ruthenium as a Binder for Cemented Carbides. V. 18, No. 4, October 1974, p. 129.

[15] Platinum Metals Review. Dispersion Strengthened Platinum. V. 18, No. 2, April 1974, pp. 46-57.

[16] Platinum Metals Review. One-Dimensional Metallic Conductors. V. 18, No. 1, January 1974, pp. 21-26.

[17] Platinum Metals Review. Coupled Reduction With Platinum-Group Metals. V. 18, No. 1, January 1974, pp. 29-34.

Potash

By William F. Keyes [1]

For the second successive year, potash production in the United States declined slightly, to 2.552 million short tons of K_2O equivalent in 1974. Under the stimulus of increased crop acreage and strong demand for farm products, however, consumption of potash, of which about 95% was used as fertilizer, increased 9% and surpassed 6 million tons of K_2O for the first time. U.S. production of potash was equal to 42% of apparent consumption. Exports declined 11%, and imports increased 21%, while producers' yearend stocks remained almost constant compared with 1973 but at a lower level than in previous years. Value of production increased 41%, to a new high of $159 million. Allowable potash production under prorationing by the Canadian Province of Saskatchewan was increased 5 times during the year, until it equaled the mines' nominal capacity of 8.3 million tons annually of K_2O; actual production in Canada was about 6 million tons, about 24% above the 1973 output. The Saskatchewan government announced a new potash policy involving two main elements: Increased taxation related to the characteristics of each mine and to the price of potash, and full or majority ownership by the Provincial government of all new mines. The Provincial government would also participate in expansion of capacity at existing mines.

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[1] Physical scientist, Division of Nonmetallic Minerals.

Table 1.—Salient statistics on potassium salts

(Thousand short tons and thousand dollars)

Item	1970	1971	1972	1973	1974
United States:					
Production	4,853	4,543	4,738	4,684	4,716
Approximate K_2O equivalent	2,729	2,587	2,659	2,603	2,552
Value	$98,123	$100,527	$106,680	$112,613	$158,974
Sales by producers	4,703	4,578	4,653	5,174	4,707
Approximate K_2O equivalent	2,669	2,592	2,618	2,865	2,545
Value at plant	$92,373	$102,099	$104,680	$123,738	$158,354
Average value per ton	$19.64	$22.30	$22.50	$23.92	$33.64
Exports [1]	966	1,033	1,353	1,579	1,415
Approximate K_2O equivalent	544	564	764	889	787
Value	$28,473	$35,323	$45,858	$57,997	$66,175
Imports for consumption [1]	4,403	4,672	4,979	r 6,046	7,245
Approximate K_2O equivalent	2,605	2,766	2,961	r 3,587	4,326
Value	$94,734	$111,844	$119,666	r $145,693	$236,747
Apparent consumption [2]	8,140	8,217	8,279	r 9,641	10,537
Approximate K_2O equivalent	4,730	4,794	4,815	r 5,563	6,084
World production, marketable:					
Approximate K_2O equivalent	20,013	21,945	r 22,060	r 24,298	26,068

r Revised.

[1] Excludes potassium chemicals and mixed fertilizers.

[2] Measured by sales plus imports minus exports.

Table 2.—Marketable potassium salts produced and sold or used in the United States, in 1974, by product

(Thousand short tons and thousand dollars)

Item	Production			Sold or used		
	Gross weight	K_2O equivalent	Value[1]	Gross weight	K_2O equivalent	Value
January–June 1974:						
Muriate of potash, 60% K_2O minimum:						
Standard	879	536	24,591	880	537	24,511
Coarse	386	236	11,315	401	245	11,740
Granular	388	235	10,741	403	245	11,169
Potassium sulfate	222	115	10,898	241	125	11,744
Other potassium salts[2]	459	141	11,692	491	155	12,628
Total[3]	2,335	1,263	69,237	2,417	1,306	71,792
July–December 1974:						
Muriate of potash, 60% K_2O minimum:						
Standard	903	550	32,714	863	526	31,458
Coarse	425	260	15,351	400	244	14,357
Granular	382	232	13,326	376	228	13,080
Potassium sulfate	217	112	14,489	218	112	14,518
Other potassium salts[2]	453	136	13,857	432	128	13,153
Total[3]	2,381	1,289	89,737	2,290	1,238	86,562
Grand total[3]	4,716	2,552	158,974	4,707	2,545	158,354

[1] Derived from reported value of "Sold or used."
[2] Includes chemical and soluble muriates, manure salts, and potassium-magnesium sulfate.
[3] Data may not add to totals shown because of independent rounding.

DOMESTIC PRODUCTION

Production of marketable potash salts, in terms of K_2O content, declined 2.0% in 1974 compared with the 1973 output. The value of production soared 41%, however, because demand was stimulated by both increased cropland under cultivation and strong worldwide markets for agricultural products. Costs of production at potash mines were severely affected by the general rise in price levels, particularly for fuel, power, and explosives.

U.S. domestic production of potash, as K_2O, equaled 42% of domestic consumption in 1974, compared with 47% in 1973. The remaining 58% of consumption was met by net imports.

In New Mexico, source of 82% of U.S. production in 1974, six underground mines were operated near Carlsbad by AMAX Chemical Corp., Duval Corp., International Minerals & Chemical Corp., Kerr-McGee Corp., National Potash Co., and Potash Co. of America.

Three companies produced potash in Utah: Texasgulf, Inc., working an underground mine near Moab by solution mining; Great Salt Lake Minerals & Chemicals Corp., producing fom brines of the Great Salt Lake; and Kaiser Aluminum & Chemical Corp., treating natural brines near Wendover.

In California, potash continued to be produced from brines of Searles Lake by the American Potash Division of Kerr-McGee Corp., at Trona. Searles Lake Chemical Corp. was also considering plans to exploit Searles Lake brines for potash.

The potash (K_2O) content of ores mined in New Mexico declined to 15.5% in 1974. In 1973 it was 16.1%; a decade earlier, in 1964, the grade of crude salts mined in the State was 18.0%.

The Teledyne mine near Carlsbad, N. Mex., which was closed in 1973, was purchased by Mississippi Chemical Corp. in July 1974 and renamed Mississippi Potash Inc. This subsidiary was merged subsequently with the parent company. Plans were announced to construct new processing facilities at a cost of $50 million; these were to be in operation by 1977. Small-scale interim operation of the old plant, which was being dismantled, was planned.

International Minerals & Chemical Corp. started a $35 million expansion of production at Carlsbad. The expansion will nearly double langbeinite (a potassium-magnesium sulfate) capacity, with some expansion of muriate capacity.

In 1974, the Federal Bureau of Mines canvassed producers of potash to determine their energy consumption. The seven operating mines in the Carlsbad area in 1973, which produced 2,168,000 tons of K_2O, reported consumption in that year of 344.28 million kilowatt-hours of electricity, 1.29 million gallons of diesel fuel, 422,000 gallons of gasoline, 767,000 gallons of other liquid fuel products, and 9.23 billion cubic feet of gas. The total energy consumption was equivalent to 11.0 trillion Btu's, converting the consumption of electricity at 3,410 Btu's per kilowatt-hour. This was equivalent to 5.09 million Btu's per ton of K_2O; 86% of the energy consumed was in the form of natural gas.

Table 3.—Production and sales of potassium salts in New Mexico
(Thousand short tons and thousand dollars)

Period	Crude salts[1]		Marketable potassium salts					
	Mine production		Production			Sold or used		
	Gross weight	K_2O equivalent	Gross weight	K_2O equivalent	Value[2]	Gross weight	K_2O equivalent	Value
1973:								
January–June	8,671	1,411	1,998	1,112	45,075	2,498	1,372	56,291
July–December	8,421	1,335	1,940	1,055	46,920	1,916	1,049	46,747
Total[3]	17,092	2,746	3,938	2,168	91,996	4,414	2,422	103,038
1974:								
January–June	8,442	1,305	1,958	1,042	56,029	2,022	1,075	57,827
July–December	8,764	1,361	1,991	1,060	72,559	1,863	986	68,196
Total	17,206	2,666	3,949	2,102	128,588	3,885	2,061	126,023

[1] Sylvite and langbeinite.
[2] Derived from reported value of "Sold or used."
[3] Data may not add to totals shown because of independent rounding.

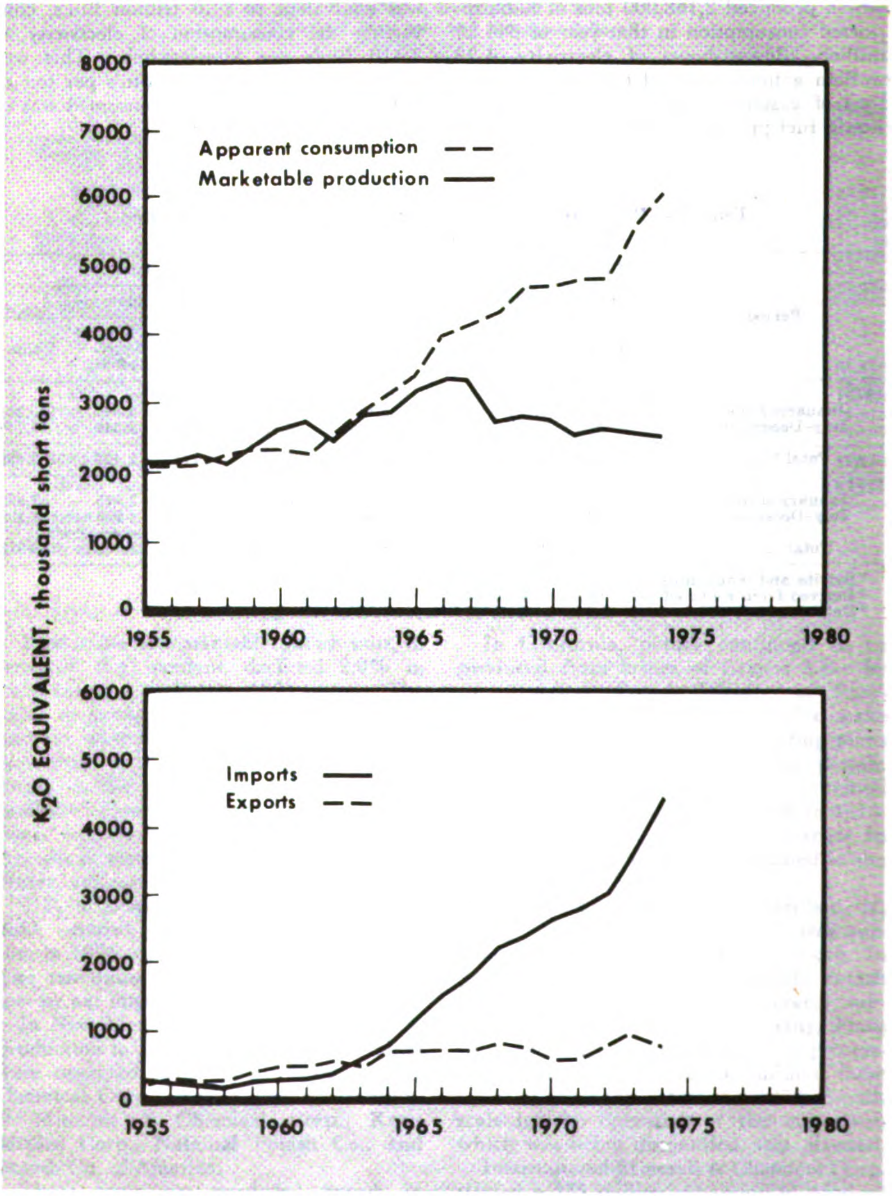

Figure 1.—Marketable production, apparent consumption, exports, and imports of potassium salts measured in K$_2$O equivalent.

CONSUMPTION AND USES

Apparent consumption of potash in the United States topped 6 million tons of K_2O for the first time in 1974; this represented a gain of 9.4% over 1973. By way of comparison, total sales of domestic and Canadian potash, according to the Potash Institute of North America, amounted to 6.04 million short tons of K_2O equivalent, including 292,000 tons (4.8%) of chemical potash sales. Imports of mined potash into the United States from overseas were reported as 121,000 tons K_2O equivalent. The north-central States of Illinois, Indiana, Iowa, Ohio, and Minnesota purchased 42% of all agricultural potash. Leading consumers of chemical potash were New York (26%), Alabama (19%), and Illinois (15%), as shown in table 4.

Table 4.—Sales of potash salts in 1974, by State of destination

(Short tons K_2O equivalent)

Destination	Agricultural potash	Chemical potash	Destination	Agricultural potash	Chemical potash
Alabama	133,022	55,826	Nevada	102	335
Arizona	1,374	47	New Hampshire	278	--
Arkansas	89,194	620	New Jersey	16,677	1,476
California	72,054	7,148	New Mexico	4,524	210
Colorado	11,846	603	New York	84,868	75,372
Connecticut	4,532	106	North Carolina	159,161	602
Delaware	26,597	23,090	North Dakota	25,045	41
Florida	237,422	1,482	Ohio	421,075	12,993
Georgia	318,433	1,982	Oklahoma	24,868	628
Hawaii	20,487	--	Oregon	16,138	1,406
Idaho	16,532	--	Pennsylvania	73,542	6,182
Illinois	688,894	43,245	Rhode Island	2,024	301
Indiana	477,377	4,993	South Carolina	114,367	494
Iowa	491,015	539	South Dakota	18,015	--
Kansas	38,012	1,779	Tennessee	126,041	42
Kentucky	123,498	22,386	Texas	308,130	15,554
Louisiana	57,252	735	Utah	840	233
Maine	16,622	212	Vermont	5,516	--
Maryland	70,705	1,835	Virginia	93,826	594
Massachusetts	4,613	564	Washington	33,778	3,054
Michigan	175,646	1,450	West Virginia	5,551	93
Minnesota	363,937	105	Wisconsin	295,247	197
Mississippi	168,693	16	Wyoming	1,707	535
Missouri	227,306	2,588			
Montana	5,392	80			
Nebraska	76,275	55	**Total**	[1]5,748,050	[2]291,828

[1] Distribution of K_2O—1,501,920 tons as standard muriate, 2,011,611 tons as coarse muriate, 1,572,025 tons as granular muriate, 409,378 tons as soluble muriate, and 253,116 tons as sulfates.

[2] Distribution of K_2O—220,576 tons as muriate, 66,591 tons as soluble muriate, and 4,661 tons as sulfates.

Source: Potash Institute of North America, Atlanta, Ga.

STOCKS

Domestic producers' stocks held steady during the year, and were 211,000 tons of K_2O at yearend 1974, compared with 206,000 tons yearend 1973. The level continued to be well below historical levels of the past two decades. Canadian producers' stocks at both onsite and offsite locations dwindled during 1974; from 530,000 tons of K_2O at yearend 1973 to 268,000 tons at yearend 1974.

Table 5.—Yearend stocks of marketable potassium salts in the United States

(Thousand short tons)

Year	Number of producers	Stocks, Dec. 31	
		Gross weight	K_2O equivalent
1970	13	875	454
1971	11	796	428
1972	11	878	468
1973	11	388	206
1974	10	394	211

PRICES

Prices continued an upward trend during 1974, as a result of competitive factors and inflation, and virtually doubled by yearend over levels dictated by the Cost of Living Council until October 1973. The 33.75 Canadian cents per unit floor price feature of the Saskatchewan Government's prorationing scheme was dropped completely in August, as being no longer necessary.

Table 6.—Bulk prices for potash in 1974[1]
(U.S. cents per unit K_2O)

	Jan. 1	Feb. 1	May 15	Aug. 1	Dec. 31
Muriate, 60% K_2O minimum:					
Standard	44	47	47	52	65
Soluble 62% to 63% to K_2O	47	50	50	57	71
Coarse	47	50	50	56	69
Granular	49	52	52	58	71
Sulfate of potash, 50% K_2O minimum:					
Standard	90	100	110	110	140
Granular	100	110	120	120	160

[1] Carlots, f.o.b. cars, Carlsbad, N. Mex.

Source: Potash Co. of America, Division of Ideal Basic Industries, Inc.

FOREIGN TRADE

U.S. exports declined 11% from the 1973 high. Latin America and countries around the rim of the Pacific were the principal destinations.

Potash imports rose by 21%. Imports from Canada increased 20% in 1974, and continued to supply 96% of all imports of potash. The second-place supplier, Israel, provided a little over 1% of U.S. imports in 1974, as in 1973, and the first significant imports from the U.S.S.R. were recorded.

Table 7.—U.S. exports of potash materials, by use

Materials	Approximate equivalent as potash (K_2O), percent	1973 Quantity (short tons)	1973 Approximate equivalent as potash (K_2O), Short tons	1973 Approximate equivalent as potash (K_2O), Percent of total	1973 Value (thousands)	1974 Quantity (short tons)	1974 Approximate equivalent as potash (K_2O), Short tons	1974 Approximate equivalent as potash (K_2O), Percent of total	1974 Value (thousands)
Used chiefly as fertilizers:									
Potassium chloride, all grades	60	1,293,607	776,164	85.8	$44,935	1,111,203	666,722	83.1	$50,058
Potassic chemical fertilizer n.e.c	40	277,750	111,100	12.3	12,825	297,040	118,816	14.8	15,780
Natural potassic salt fertilizers, crude	20	7,359	1,472	.1	237	6,355	1,271	.2	337
Total	--	1,578,716	888,736	98.2	57,997	1,414,598	786,809	98.1	66,175
Used chiefly in chemical industries:									
Potassium hydroxide	80	7,581	6,065	.7	1,221	6,505	5,204	.6	1,603
Potassium peroxide	83	24	20	--	23	655	544	.1	36
Potassium compounds, n.e.c	31	31,624	9,803	1.1	9,416	31,130	9,650	1.2	13,073
Total	--	39,229	15,888	1.8	10,660	38,290	15,398	1.9	14,712
Grand total	--	1,617,945	904,624	100.0	68,657	1,452,888	802,207	100.0	80,887

Table 8.—U.S. exports of potash materials, by country

Destination	Fertilizer								Chemical							
	Chloride quantity (short tons)		Chemical fertilizer n.e.c., quantity (short tons)		Total				Hydroxide (caustic), quantity (short tons)		Other n.e.s., quantity (short tons)		Total			
					Quantity (short tons)	Value (thousands)	Quantity (short tons)	Value (thousands)					Quantity (short tons)	Value (thousands)	Quantity (short tons)	Value (thousands)
	1973	1974	1973	1974	1973		1974		1973	1974	1973	1974	1973		1974	
Argentina	5,909	2,205	8,672	4,742	14,581	$565	6,947	$340	--	6	1,290	322	1,290	$176	328	$205
Australia	85,315	162,756	9,162	796	94,477	8,091	[1]167,274	[1]6,873	48	66	640	928	688	399	994	560
Belgium-Luxembourg	--	--	525	--	525	19	--	--	30	105	499	282	529	624	387	271
Brazil	407,021	208,535	10,750	15,462	417,771	14,834	223,997	10,218	1,046	1,140	8,542	1,110	9,588	997	2,250	942
Canada	1,506	4,804	79,392	88,384	80,898	3,838	[1]93,682	[1]4,587	3,171	3,121	6,599	9,831	9,770	2,216	12,952	4,006
Chile	441	21	1,708	--	2,149	84	21	1	--	--	78	50	78	20	50	17
Colombia	91,266	42,160	139	22,388	91,405	3,240	64,548	3,467	13	64	63	6,123	76	36	6,187	410
Costa Rica	43,253	26,318	9,259	7,651	52,512	1,725	33,969	1,700	2	1	17	17	19	5	18	29
Dominican Republic	30,566	22,185	2,399	1,674	32,965	1,328	23,953	1,359	4	--	559	38	563	83	38	21
Ecuador	9,883	2,877	--	--	9,883	361	2,877	141	--	55	2	39	2	3	94	57
Finland	10,521	17,085	--	--	10,521	308	17,085	500	--	--	--	--	--	--	--	--
France	--	--	--	--	--	--	--	--	--	--	1	154	1	(2)	154	100
Germany, West	--	--	--	--	--	--	--	--	113	5	2,045	4,017	2,158	1,007	4,022	1,940
Guatemala	2,654	--	--	--	2,654	89	--	--	19	49	30	7	49	18	56	22
Honduras	40	--	378	3,376	418	14	3,376	260	--	--	3	250	3	4	250	22
India	--	22	--	--	--	--	22	1	--	--	49	151	49	13	151	41
Indonesia	--	45	--	--	--	--	45	15	5	5	109	929	114	34	934	629
Ireland	24,551	40,626	--	--	24,551	844	40,626	1,783	6	--	5	7	11	2	7	5
Israel	--	87	--	--	--	--	87	3	226	63	43	14	269	47	77	33
Italy	--	--	--	--	--	--	[1]40	[1]1	20	--	12	69	32	18	69	33
Jamaica	14,762	10,400	19	--	14,781	528	10,400	766	16	24	30	26	46	17	50	34
Japan	100,727	109,409	80,650	81,526	[1]187,439	[1]8,361	[1]191,144	[1]9,628	--	55	3,225	1,153	[3]3,248	[3]1,139	1,208	1,468
Korea, Republic of	--	--	22,197	21,842	22,197	901	21,842	1,078	--	194	188	128	188	82	[3]329	[3]158
Mexico	72,033	77,005	23,560	27,079	[1]96,718	[1]2,721	104,084	3,185	1,438	611	2,820	2,025	[3]4,259	[3]1,402	[3]2,639	[3]1,224
Netherlands	16	6	--	--	16	1	6	1	34	45	242	292	276	117	337	240
Netherlands Antilles	--	76	--	--	--	--	76	2	341	111	(2)	(2)	341	84	111	48
New Zealand	243,624	217,366	--	--	243,624	7,739	217,366	8,571	38	--	135	102	173	57	102	74
Peru	8,099	10,967	--	2,502	8,099	346	13,469	865	10	10	120	87	130	62	97	65
Philippines	18,491	74,084	--	48	18,491	608	74,132	4,081	14	4	230	280	[3]249	[3]56	284	170
Singapore	1,488	--	3,300	10,084	4,788	178	10,084	778	--	4	20	72	20	55	76	33
South Africa, Republic of	45	150	--	--	45	2	150	5	510	110	155	206	665	195	316	168
Sweden	9,869	1,692	--	--	9,869	287	1,692	111	--	--	562	38	562	44	38	30
Taiwan	65,306	26,911	4,829	--	70,135	2,395	26,911	1,751	5	--	585	549	590	272	549	306
U.S.S.R	--	--	--	--	--	--	--	--	--	--	885	--	885	319	--	--
United Kingdom	--	--	--	--	--	--	[1]66	[1]2	142	115	958	660	1,100	515	775	428

Table 8.—U.S. exports of potash materials, by country—Continued

Destination	Fertilizer								Chemical							
	Chloride quantity (short tons)		Chemical fertilizer n.e.s., quantity (short tons)		Total				Hydroxide (caustic), quantity (short tons)		Other n.e.c., quantity (short tons)		Total			
					Quantity (short tons)	Value (thousands)	Quantity (short tons)	Value (thousands)					Quantity (short tons)	Value (thousands)	Quantity (short tons)	Value (thousands)
	1973	1974	1973	1974	1973		1974		1973	1974	1973	1974	1973		1974	
Venezuela	9,583	34,254	3,505	--	13,129	$377	[1] 34,277	$2,372	272	396	316	444	588	$246	[3] 1,485	[3] $368
Vietnam, South	16,309	4,081	2,903	--	19,212	1,796	4,081	257	--	--	180	110	180	45	110	20
Other	20,329	15,126	14,403	9,586	[1] 34,868	[1] 1,427	[1] 26,319	1,533	58	146	387	670	445	251	816	540
Total	1,293,607	1,111,208	277,750	297,040	[1] 1,578,716	[1] 57,997	[1] 1,414,598	[1] 66,175	7,581	6,505	31,624	31,130	[3] 39,229	[3] 10,660	[3] 38,290	[3] 14,712

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[1] Includes crude natural potassic salt fertilizer—1973: Japan, 6,062 tons ($201,436); Mexico 1,120 tons ($29,180); Bahamas, 97 tons ($3,237); Venezuela, 41 tons ($1,380); Nicaragua, 39 tons ($1,320). 1974: Australia, 3,722 tons ($238,195); Poland, 1,089 tons ($36,500); Canada, 544 tons ($26,872); Hong Kong, 361 tons ($13,699); Japan, 209 tons ($6,981); Dominican Republic 144 tons ($4,814); Nicaragua, 72 tons ($2,400); Saudi Arabia, 69 tons ($2,319); the United Kingdom, 66 tons ($2,226); Italy, 40 tons ($1,324); Venezuela, 23 tons ($785); Switzerland, 16 tons ($530).

[2] Less than ½ unit.

[3] Includes potassium peroxide—1973: Japan, 18 tons ($17,966); Philippines, 5 tons ($4,288); Mexico 1 ton ($680). 1974: Venezuela, 645 tons ($25,488); Republic of Korea, 7 tons ($6,500); Mexico, 3 tons ($3,518).

Table 9.—U.S. imports for consumption of potash materials, by use

Materials	Approximate equivalent as potash (K_2O), percent	1973				1974			
		Quantity (short tons)	Approximate equivalent as potash (K_2O)		Value (thousands)	Quantity (short tons)	Approximate equivalent as potash (K_2O)		Value (thousands)
			Short tons	Percent of total			Short tons	Percent of total	
Used chiefly as fertilizers:									
Muriate (chloride)	60	5,898,988	3,539,393	[r]98.5	$137,691	7,145,585	4,287,351	98.9	$228,623
Potassium nitrate, crude	40	[r]29,935	[r]11,974	[r].3	[r]2,334	14,109	5,644	.1	1,797
Potassium sodium nitrate mixtures, crude	14	53,280	7,459	.2	2,737	25,934	3,631	.1	2,489
Potassium sulfate, crude	50	[r]54,652	[r]27,326	.8	[r]2,660	57,882	28,941	.7	3,734
Other potash fer- tilizer material	6	8,757	525	--	271	1,419	851	--	104
Total	--	[r]6,045,612	[r]3,586,677	99.8	[r]145,693	7,244,929	4,326,418	99.8	236,747
Used chiefly in chemical industries:									
Bicarbonate	46	996	458	.2	175	1,409	648	.2	400
Bitartrate:									
Argols	20	--	--		--	6	1		7
Cream of tartar	25	1,113	278		748	1,417	354		2,550
Carbonate	61	1,747	1,066		296	2,168	1,319		470
Caustic	80	1,052	842		295	1,871	1,497		752
Chlorate and perchlorate	36	517	186		129	437	157		125
Cyanide	70	732	512		360	1,151	806		717
Ferricyanide	42	708	297		585	840	353		999
Ferrocyanide	44	913	402		441	1,341	590		897
Nitrate	50	704	352		97	318	159		31
Rochelle salts	22	482	106		266	556	122		712
All other	31	9,736	3,337		7,972	8,784	2,723		11,675
Total	--	18,700	7,836	.2	11,364	20,293	8,729	.2	19,335
Grand total	--	[r]6,064,312	[r]3,594,513	100.0	[r]157,057	7,265,222	4,335,147	100.0	256,082

[r] Revised.

Table 10.—U.S. imports for consumption of potash materials, by country

(Short tons)

Year and country	Bitartrate cream of tarter	Caustic (hydroxide)	Chlorate and perchlorate	Cyanide	Muriate (chloride)	Potassium nitrate, crude	Potassium sodium nitrate mixtures, crude	Potassium nitrate (saltpeter) refined	Potassium sulfate	All others	Total	
											Quantity	Value (thousands)
1973:												
Belgium-Luxembourg	--	--	--	3	--	--	--	--	--	652	655	$404
Brazil	--	--	--	--	11,629	--	--	--	--	--	11,629	288
Canada	4	--	--	4	5,808,606	568	329	--	--	[r] 9,169	[r] 5,818,680	136,033
Chile	--	--	--	--	--	--	31,534	--	--	--	31,534	1,447
Congo (Brazzaville)	--	--	--	--	6,007	--	--	--	--	--	6,007	177
Finland	--	--	--	--	--	--	--	--	--	1,824	1,824	226
France	--	50	--	1	3,000	5,032	--	--	20,660	1,336	30,079	1,862
Germany, West	--	263	--	465	--	--	--	89	[r] 33,992	4,005	[r] 38,764	[r] 3,956
Israel	--	--	--	--	44,380	14,914	10,415	665	--	14	70,388	[r] 4,020
Italy	729	--	--	--	--	--	--	--	--	94	823	543
Japan	--	204	--	125	--	--	--	--	--	2,183	2,512	4,116
Netherlands	--	--	3	--	7,398	--	--	--	--	3,006	10,407	1,201
Netherlands Antilles	--	--	--	--	--	9,421	--	--	--	--	9,421	358
Norway	--	--	--	--	--	--	11,002	--	--	--	11,002	484
Spain	340	--	199	--	17,968	--	--	--	--	362	18,869	1,082
Sweden	--	469	262	--	--	--	--	--	--	(1)	731	250
United Kingdom	--	46	--	184	--	--	--	--	--	619	799	464
Other	40	20	53	--	--	--	--	--	--	[r] 75	[r] 188	146
Total	1,113	1,052	517	732	5,898,988	[r] 29,935	53,280	704	[r] 54,652	23,339	[r] 6,064,312	[r] 157,057
1974:												
Argentina	148	--	--	--	--	--	--	--	--	--	148	139
Belgium-Luxembourg	--	41	--	--	--	--	--	--	7,722	1.139	8,902	1,201
Canada	5	355	--	--	6,991,920	281	922	--	329	680	6,994,492	224,088
Chile	--	--	--	--	--	2,000	12,958	--	--	1,093	16,051	1,438
Dahomey	--	--	--	--	14,893	--	--	--	--	--	14,893	1,067
Finland	--	--	--	--	--	--	--	--	--	1,515	1,515	187
France	--	30	--	--	--	--	--	--	7,496	867	8,393	881
Germany, West	--	527	--	583	10,016	--	--	20	42,335	5,684	59,165	7,892
Israel	--	--	--	--	87,401	11,828	5,953	80	--	--	105,262	5,619
Italy	807	--	--	(1)	--	--	--	--	--	60	867	1,787
Japan	--	229	--	107	--	--	--	--	--	2,917	3,253	6,237
Netherlands	--	21	--	--	--	--	--	218	--	1,512	1,751	1,040
Norway	--	--	--	--	--	--	6,101	--	--	--	6,101	515
Spain	449	--	173	--	--	--	--	--	--	427	1,049	1,267
Sweden	--	602	247	--	--	--	--	--	--	20	869	427
U.S.S.R	--	--	--	--	41,249	--	--	--	--	--	41,249	1,459
United Kingdom	--	66	7	461	106	--	--	--	--	494	1,134	691
Other	8	--	10	--	--	--	--	--	--	109	127	147
Total	1,417	1,871	437	1,151	7,145,585	14,109	25,934	318	57,882	16,517	7,265,221	256,082

[r] Revised.

[1] Less than ½ unit.

WORLD REVIEW

Estimated world production of potash increased 7.3% in 1974.

Australia.—Unforeseen difficulties delayed the attainment of full production at the Lake McLeod potash refinery of Texada Mines, Pty. Ltd., Western Australia. The plant, an adjunct to salt production, is expected to produce 200,000 tons per year of langbeinite.

Brazil.—The terms of the agreement between Petróleo Brasileiro S.A. (PETROBRAS) and the Lume group to exploit the Sergipe potash deposits were announced. Their respective subsidiaries, Petroquisa S.A. and Comminerium Mineração S.A., each acquired 50% of the ordinary common stock of Kalium Mineração S.A., which earlier had won the competitive bidding to exploit the deposits. Some $90 million will be invested in the project. Production of potassium chloride was expected to reach 1 million tons by 1978 and 2 million tons by 1992, making Brazil self-sufficient in potash.[2]

Canada.—Prorationing quotas were raised by the Government of Saskatchewan 5 times during 1974, and in August reached the nominal capacity of the mines, 8.3 million tons per year of K_2O. Actual production reached 6 million tons during the year, and it appeared that full capacity could not be approached for some time. The minimum price feature of the prorationing scheme, which was 33.75 Canadian cents per short ton unit, was dropped completely in July. In October the Government of Saskatchewan announced a new potash policy involving two main elements: A new and additional "reserves" tax related to the characteristics of the mine (ore reserves, capacity, costs, etc.) and to the price of potash; and full or majority ownership by the Saskatchewan Government of all new mines, as well as participation in all mine expansion. The industry reacted by declaring it could not proceed with expansion plans that it had under consideration.

The Potash Co. of America continued drilling in 1974 on the potash horizon near Sussex, New Brunswick, Canada. Assessment of results was complicated by the structural complexity within the deposit. The area is approximately 20 miles from the Bay of Fundy and 40 miles by highway from St. John.

Exploration licenses were granted by the Nova Scotia Government to AMAX Exploration, Inc., and St. Joseph Exploration Co. to look for potash in the Antigonish and Stewiacke regions.

A summary of .the economic geology of New Brunswick evaporites was published.[3] Lower Carboniferous strata containing evaporites underlie a 3,000-square-mile portion of southeast New Brunswick. Sulfates (including glauberite), halite, and limestone (Albert Formation) occur within the lower part of the succession. Above the Albert Formation, and separated from it by red beds, are limestone, gypsum-anhydrite, halite, and sylvite (Windsor Group), overlain in turn by red beds. In the Windsor Group core drilling has encountered as much as 51 continuous feet of sylvinite (sylvite, KCl mixed with halite, NaCl).

Israel.—The Israeli Government's Dead Sea Works planned to increase its production of potash from 1 million tons of product per year to 1.2 million by the end of 1975, at a cost of $20 million. Further expansion to 1.5 million tons was envisioned.[4]

Italy.—All Italian potash production was under control of Industria Sali Potassici e Affini S.p.A. (ISPEA), which is owned 60.7% by Ente Minerario Siciliano (EMS), an entity of the Sicilian Government; 33.3% by Montecatini Edison S.p.A. (Montedison), a private company; and 6% by Ente Nazionale Idrocarburi (ENI), owned by the Italian Government.[5]

Laos.—The Cretaceous potash beds underlying extensive areas in Thailand are thought, from preliminary evidence, to extend into Laos on the Vientiane plain and east and south between Thakhet and Savannakhét. Plans were made by the Laos Government, with U.S. Government aid, to explore them further.

Poland.—Exploration continued on a deposit in the Bay of Puck, north of Gdynia.[6]

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[2] U.S. Consulate, Salvador, Brazil. State Department Airgram A–11, Dec. 6, 1974, 3 pp.

[3] Davis, D. W. New Brunswick Evaporites in an Economic Context. Industrial Minerals, No. 81, June 1974, p. 37.

[4] Israel Industry & Commerce and Export News. V. 25, No. 5, December 1974, p. 3.

[5] Industrial Minerals. Potash Today. No. 80, May 1974, pp. 11–19.

[6] Phosphorus and Potassium. No. 70, March–April 1974, p. 15.

Thailand.—An extensive basin containing potash deposits was investigated by the Thai Government with the cooperation of the U.S. Geological Survey. Four drillholes produced evidence of a 100-foot-thick carnallite deposit underlying 1,500 square miles centered around Udon Thani, in northern Thailand, at depths of 294 to 1,520 feet below the surface. Sylvite is present in small amounts, suggesting that economic deposits of this mineral may be found. A southern subbasin at Khorat was as yet untested, but might contain even larger reserves of potash. The basin extends into Laos around Vientiane, where a high-grade sylvite deposit was located.[7]

U.S.S.R.—Exploratory drilling continued in a fourth area of possible potash reserves. This was the Gusev deposit, near Kaliningrad on the Baltic Sea. The potash horizon is said to be up to 390 feet thick and of high grade. A mine here would be well situated to supply export markets.[8]

On May 21, 1974, the U.S. Export-Import Bank announced that it had authorized a credit of $180 million to the U.S.S.R. to assist in importing U.S. goods and exporting fertilizer raw materials to the United States. Under the terms of the overall program, the United States would export superphosphoric acid to the U.S.S.R. and import potash and nitrogen (ammonia and urea) from the U.S.S.R. The Export-Import Bank was to be involved only in financing U.S. exports of equipment, on favorable terms, to enable the U.S.S.R. to produce and ship the nitrogen materials, but its participation was also designed to encourage the overall barter agreement.[9]

United Kingdom.—The mine of Cleveland Potash, Ltd., at Boulby, Yorkshire, operated on a limited scale; full production was expected when the second shaft was completed in 1975. The delay was occasioned by problems associated with sealing off the brine-bearing Bunter Sandstone between depths of 2,000 and 3,000 feet. Both shafts reached a depth of about 3,700 feet, some 100 feet below the ore body. The ore is mined by the room-and-pillar system, and concentration is by flotation, with facilities for manufacturing, crystallization, and compaction products as well. The tailings are discharged into the sea a mile offshore through a pipeline installed in a tunnel below the seabed.[10]

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[7] U.S. Department of State Telegram No. 19096 to Bangkok, Thailand, Jan. 27, 1975.

[8] Page 14 of work cited in footnote 6.

[9] Export-Import Bank of the United States. News Release, May 21, 1974, 2 pp.

[10] Stedman, R. E. First U.K. Potash Mine Enters Production. European Chemical News—Chemscope, Large Plants Supplement, Oct. 18, 1974, pp. 46, 48.

Table 11.—Marketable potash: World production by country

(Thousand short tons, K_2O equivalent)

Country [1]	1972	1973	1974 [p]
Canada	3,852	4,909	6,072
Chile	26	28	[e] 29
China, People's Republic of [e] [2]	310	330	375
Congo (Brazzaville)	317	294	[e] 350
France	[r] 1,941	2,494	2,508
Germany, East	2,709	2,818	3,158
Germany, West [3]	2,698	2,809	2,888
Israel	618	642	[e] 660
Italy	238	237	[e] 230
Spain	703	630	546
U.S.S.R	5,989	6,504	[e] 6,700
United States	2,659	2,603	2,552
Total	[r] 22,060	24,298	26,068

[e] Estimate. [p] Preliminary. [r] Revised.

[1] In addition to the countries listed, Australia and the United Kingdom produced small, unreported quantities of marketable potash in 1974 from newly developed facilities.

[2] Data are for year ending June 30 of that stated.

[3] Series revised to provide data on marketable potash rather than on run-of-mine production reported in previous editions of this chapter.

Source: British Sulphur Corp. Ltd. Statistical Supplement No. 10, November-December 1974, London 1974, pp. 18–19.

TECHNOLOGY

Work at the University of Tennessee's Space Institute has demonstrated that experimentally observed absorption of potassium seed in the slag of a coal-fired magnetohydrodynamic electrical generator is much less than theoretical predictions, and will therefore not be a problem.[11]

The Federal Bureau of Mines concluded testing of flotation methods to concentrate low-grade potash salts harvested from evaporation ponds treating Great Salt Lake brines. Tests indicated that 80% of the potash in salts containing 5% to 6% potassium could be recovered by converting the kainite in the salts to schoenite in a high-$MgSO_4$ brine and floating the schoenite with medium-molecular-weight fatty acids. A report was being prepared by the Bureau, and a 10-to 15-ton-per-hour pilot plant was being constructed by the Great Salt Lake Minerals & Chemical Corp. to develop the process.

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[11] U.S. Department of the Interior, Office of Coal Research. Shaping Coal's Future through Technology. Annual Report 1974–75, pp. 80–84.

Pumice and Volcanic Cinder

By Arthur C. Meisinger [1]

Total domestic production of pumiceous materials in 1974 was 100 tons below the record quantity of 3,936,700 tons (revised) in 1973, and the value of production was a record $9.1 million. Pumice and pumicite production increased for the fourth consecutive year, and although volcanic cinder and scoria output was slightly under the record quantity (revised) of 3.1 million tons in 1973, value of production was a record $5.45 million in 1974.

The individual outputs of Arizona, California, and Oregon again led all other pumiceous material producing States. The use of pumiceous materials for road construction and maintenance and concrete admixtures and aggregates, combined, accounted for 82% of U.S. consumption in 1974. Price increases for pumice and volcanic cinder were noted in all major end uses in 1974—ranging from only a $0.05 per ton increase for railroad ballast to nearly a $5 per ton increase for landscaping.

Exports and imports of pumice in 1974 declined 6% and 5.6% in quantity, respectively, but values increased 58% and 32%, respectively, owing primarily to continued inflationary costs.

DOMESTIC PRODUCTION

The quantity of pumiceous materials (pumice, pumicite, volcanic cinder, and scoria) produced in the United States in 1974 was 3,936,600 tons, or nearly the same as the record quantity of 3,936,700 tons (revised) in 1973. Value of domestic production was a record $9.1 million in 1974 compared with the previous record value (revised) of $8.9 million in 1973.

Production of pumice and pumicite increased for the fourth consecutive year and totaled 873,000 tons valued at nearly $3.7 million. Production of volcanic cinder and scoria in 1974 was 3,064,000 tons, or only 49,000 tons under the record quantity of 3,113,000 tons (revised) produced in 1973, and was valued at a record $5.45 million. Volcanic cinder and scoria comprised 78% of the domestic output of pumiceous materials, compared with 79% in 1973.

Domestic output in 1974 came from 92 individuals, firms, and governmental agencies producing from 289 operations in 12 States, compared with 88 producers and 164 operations (revised) in 13 States in 1973. The increase of more than 100 operations over those in 1973 was directly related to increased demand for volcanic cinder for use on roads in National Forest lands in several western States.

The principal producing States in 1974, in order of output, were Oregon, California, and Arizona, and their combined output of pumiceous materials accounted for 68% of the national total. Other States with significant output were Hawaii, Nevada, and New Mexico. Of the six leading States, three (California, Hawaii, and New Mexico) showed production increases in 1974, and three (Arizona, Nevada, and Oregon) had declines in output.

California led all the producing States in 1974 with 130 active operations, followed by Arizona with 58, Oregon with 39, and Hawaii with 27. Volcanic cinder was produced in 11 of the 12 States and in American Samoa.

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[1] Industry economist, Division of Nonmetallic Minerals.

Table 1.—Pumice, pumicite, and volcanic cinder sold or used in the United States[1]
(Thousand short tons and thousand dollars)

Year	Pumice and pumicite		Volcanic cinder		Total	
	Quantity	Value	Quantity	Value	Quantity	Value
1970	490	1,233	2,546	3,438	3,036	4.671
1971	540	1,396	2,851	3,818	3,391	5.214
1972	790	1,878	3,028	4,661	3,818	6.539
1973	824	3,612	r 3,113	r 5,269	r 3,937	r 8,881
1974	873	3,669	3,064	5,452	3,937	9,121

r Revised.

[1] Values f.o.b. mine, 1970–71; values f.o.b. mine or mill, 1972–74.

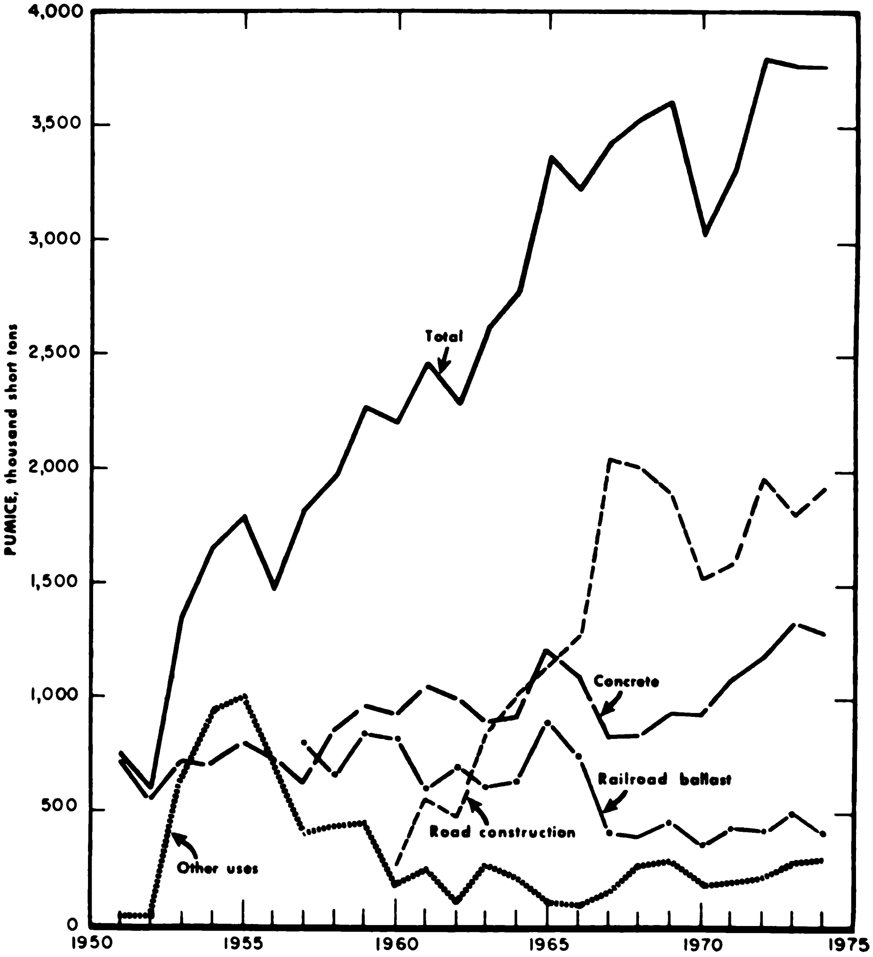

Figure 1.—Pumice and volcanic cinder sold or used by producers in the United States by use.

Table 2.—Pumice, pumicite, and volcanic cinder sold or used by producers in the United States, by State

(Thousand short tons and thousand dollars)

State	1973		1974	
	Quantity	Value	Quantity	Value
Arizona	853	715	846	865
California	768	3,237	909	3,219
Hawaii	354	611	385	792
Idaho	80	110	108	182
New Mexico	339	1,001	471	1,466
Oregon	r 1,171	r 2,013	915	1,887
Utah	42	57	15	19
Washington	1	1	(1)	1
Other States [2]	328	1,136	288	690
Total	[3] r 3,937	r 8,881	3,937	9,121
American Samoa	37	214	27	183

r Revised.

[1] Less than 1 unit.

[2] Colorado, Kansas, Nevada, Oklahoma, and Wyoming (1973).

[3] Data may not add to total shown because of independent rounding.

CONSUMPTION AND USES

The use of pumiceous materials for road construction and maintenance and concrete admixtures and aggregates, combined, accounted for 82% of U.S. consumption in 1974, compared with 80% (revised) in 1973. Of the remainder, railroad ballast comprised nearly 11%; abrasives and other uses, 4%; and landscaping, 3%. Compared with consumption in 1973, use in road construction increased 6%, and abrasives and other uses increased 35%; however, the other major end-use categories showed declines of 17% for railroad ballast, 27% for landscaping, but only 3% for concrete aggregate and admixture.

Table 3.—Pumice, pumicite, and volcanic cinder sold or used by producers in the United States, by use

(Thousand short tons and thousand dollars)

Use	1973		1974	
	Quantity	Value	Quantity	Value
Abrasive—(cleaning and scouring compounds)	20	541	17	527
Concrete admixture and concrete aggregate	1,320	2,948	1,284	3,363
Landscaping	153	770	111	1,107
Railroad ballast	504	529	420	462
Road construction (includes ice control and maintenance	r 1,816	r 2,215	1,927	2,517
Other uses [1]	125	1,878	179	1,145
Total [2]	r 3,937	r 8,881	3,937	9,121

r Revised.

[1] Includes miscellaneous abrasive uses, absorbents, heat-or-cold insulating medium, roofing, soil conditioners (1974), and miscellaneous uses.

[2] Data may not add to totals shown because of independent rounding.

PRICES

The average value for crude pumice, pumicite, and volcanic cinder sold and used increased from $0.93 per ton (revised) in 1973 to $1.10 per ton in 1974. The average value for prepared material increased also—from $3.60 per ton in 1973 to $3.72 per ton. The weighted average value of pumiceous materials was $2.32 per ton compared with $2.26 per ton (revised) in 1973.

Increases in average prices for all major end uses of pumiceous materials (except "Other uses") were reported in 1974. Compared with 1973, the average price per ton for pumice and volcanic cinder used in cleaning and scouring compounds in 1974 was $31, a $3.95 increase; for concrete admixtures and aggregates, $2.62, a $0.39 increase; for landscaping, $9.97, a $4.94 increase; for railroad ballast, $1.10, a $0.05 increase; and for road construction, $1.31, a $0.09 increase. The category of other uses declined in average price from $15.02 per ton in 1973 to $6.40 per ton.

American Paint & Coatings Journal reported no change in the prices for pumice stone in 1974. Quoted prices at yearend were as follows per pound, bagged f.o.b. New York or Chicago: Powdered, $0.0445 to $0.08, and lump, $0.0665 to $0.09.

Price quotations for pumice in Chemical Marketing Reporter, which were changed in May 1973, remained in effect throughout 1974 and were as follows: Domestic grades, bagged in ton lots, fine, $0.0765 to $0.1140 per pound; medium, $0.1160 per pound; coarse, $0.094 per pound; imported (Italian) silk-screened, bagged in ton lots, fine, $138 per ton; medium, $150 per ton; and coarse, $140 per ton. Price of imported small and large lump size was quoted at $275 per ton.

FOREIGN TRADE

Exports of pumice, pumicite, and volcanic cinder (scoria) in 1974 declined 6% to 2,911 tons, from the record quantity of 3,095 tons in 1973. West Germany received 2,184 tons, or 75% of the total quantity exported to 16 countries in 1974.

Pumice imports in 1974 declined for the second straight year; however, the quantity was only 5.6% less than that of 1973, compared with the 48% decline in quantity from 1972 to 1973. The value of imports in 1974 increased 32% over that of 1973. Total value of all import classes, primarily from Italy and Greece, was $1.52 million in 1974 compared with $1.15 million in 1973.

Imported pumice used in the manufacture of concrete masonry products declined 7% from that of 1973, and imports classed as wholly or partly manufactured declined 21%. However, crude or unmanufactured imports of pumice from Italy increased 67% from 5,026 tons in 1973 to 8,415 tons.

Pumice stone, TSUS No. 519.05, for use in concrete products continued to be admitted into the United States duty free. Duties for other products at yearend were unchanged from 1973 as follows: TSUS No. 519.11, crude or crushed pumice, valued not over $15 per ton, 0.02 cent per pound; TSUS No. 519.14, crude or crushed pumice, valued over $15 per ton, 0.04 cent per pound; TSUS No. 519.31, in grains or ground, pulverized or refined, 0.17 cent per pound; and TSUS Nos. 519.93 and 523.61, millstones, abrasive wheels, and abrasive articles, n.s.p.f. and articles, n.s.p.f., 7% ad valorem.

Table 4.—U.S. exports of pumice

Year	Quantity (short tons)	Value (thousands)
1971	357	$51
1972	256	34
1973	3,095	765
1974	2,911	1,211

Table 5.—U.S. imports for consumption of pumice, by class and country

Country	Crude or unmanufactured		Wholly or partly manufactured		Used in the manufacture of concrete masonry products		Manufactured n.s.p.f.
	Quantity (short tons)	Value (thousands)	Quantity (short tons)	Value (thousands)	Quantity (short tons)	Value (thousands)	Value (thousands)
1973:							
Greece	--	--	--	--	193,922	$501	--
Italy	5,026	$95	2,740	$215	108,738	321	$4
Mexico	--	--	(1)	1	--	--	--
Other [2]	--	--	--	--	--	--	15
Total	5,026	95	2,740	216	302,660	822	19
1974:							
Greece	--	--	--	--	202,588	394	--
Italy	8,415	228	2,167	152	79,535	663	9
Mexico	--	--	--	--	215	4	48
Other [3]	--	--	(1)	1	--	--	23
Total	8,415	228	2,167	153	282,338	1,061	80

[1] Less than ½ unit.

[2] Canada, the People's Republic of China, France, West Germany, Japan, the U.S.S.R., and the United Kingdom.

[3] Canada, West Germany, Italy, Japan, Mexico, the U.S.S.R., and the United Kingdom.

Table 6.—Pumice and related volcanic materials: World production, by country

(Thousand short tons)

Country [1]	1972	1973	1974 [p]
Argentina [2]	36	38	[e] 40
Austria: Pozzolan	31	27	20
Cape Verde Islands: Pozzolan	9	13	[e] 17
Chile: Pozzolan	175	157	179
Costa Rica	2	2	3
Dominica	[r] [e] 121	125	[e] 126
Egypt, Arab Republic of	(3)	(3)	[e] (3)
Ethiopia [4]	(3)	(3)	(3)
France:			
Pumice [e]	1	1	1
Pozzolan and lapilli	[r] 785	[r] [e] 827	888
Germany, West (marketable)	5,534	4,182	2,316
Greece:			
Pumice	[r] 588	835	574
Pozzolan	[r] 725	798	905
Guadeloupe: Pozzolan	[r] [e] 110	176	[e] 176
Guatemala: Volcanic ash (for cement) [e]	[r] 55	[r] 55	55
Iceland	[5] 19	21	[5] 8
Italy:			
Pumice and pumiceous lapilli [e]	[r] 880	[r] 880	880
Pozzolan [e]	[r] 3,860	[r] 3,860	3,860
Martinique: Pumice	[r] [e] 138	167	122
New Zealand	143	63	78
Spain [6]	166	195	[e] 210
United States (sold or used by producers):			
Pumice and pumicite	790	824	873
Volcanic cinder [7]	3,029	3,150	3,091
Total	[r] 17,197	16,396	14,422

[e] Estimate. [p] Preliminary. [r] Revised.

[1] Pumice is also produced in Iran, Japan, Mexico, and the U.S.S.R. (sizable quantity), but data on production are not available.

[2] Unspecified volcanic materials produced mainly for use in construction products.

[3] Less than ½ unit

[4] Includes Eritrea.

[5] Exports.

[6] Includes Canary Islands.

[7] Includes American Samoa.

Rare-Earth Minerals and Metals

By James H. Jolly [1]

World production of rare-earth oxide (REO) contained in concentrate increased slightly in 1974, despite the continuing decline in world monazite output. The increase was due to record production of bastnaesite at Mountain Pass, Calif., by Molycorp Inc., which produced more than 70% of the total world REO output. Monazite production continued to be adversely affected by decreasing monazite contents at some heavy mineral mines, rising costs, and plant problems. Production of rare-earth compounds and metals was adequate to meet market demand. Prices for rare-earth concentrates and compounds increased selectively by 10% to 40%. Further price increases were expected in 1975.

The domestic rare-earth industry in 1974 was highlighted by record production, development of a new placer deposit from which byproduct monazite was recovered, expansion of production facilities, and a high level of shipments and exports of rare-earth materials. The Rare Earth Metals Co. of America (REMCOA) successfully completed pilot plant tests using a Bureau of Mines-developed process to produce mischmetal and planned to construct a 125-ton-yer-year demonstration unit. The overall end-use consumption pattern of rare earths was similar to that of 1973. Petroleum catalysts continued to be the major consumer. The second largest use was as additives in iron and steel production. This use remained at the 1973 level despite reduced demand of steel by the automotive industry.

Legislation and Government Programs.—At the end of 1974, the General Services Administration (GSA) held a total of 9,124 short tons (dry) of REO equivalent in the national (7,198 tons) and supplemental (1,926 tons) stockpiles. Disposals for the year amounted to 2,553 tons of contained REO. The Y_2O_3 stockpile remained unchanged at 237 pounds. The rare-earth elements were removed from the list of strategic and critical materials in March 1971 and were authorized for orderly disposal to industry.

During 1974, the Office of Minerals Exploration (OME), U.S. Geological Survey, continued financial assistance of 50% of approved costs for exploration for rare-earth and yttrium resources.

DOMESTIC PRODUCTION

Concentrate.—In 1974, domestic production of REO in concentrate exceeded the 1973 record high by 11.2%. More than 90% of production was in the form of bastnaesite; the remainder was in the form of monazite.

The Mountain Pass, Calif., operation of Molycorp, Inc., produced about 21,950 tons of REO contained in bastnaesite concentrate in 1974, compared with about 19,350 tons in 1973.[2] Molycorp completed a 50% expansion of its milling and flotation facilities, to 30,000 tons REO annually, in January. However, because of delays in delivery of auxiliary equipment and shortages of chemical reagents, the new plant did not operate near its design capacity until the fourth quarter.

Titanium Enterprises, jointly owned by American Cyanamid Co. and Union Camp Corp., continued to recover monazite as a byproduct of mining Pleistocene beach sands for titanium minerals and zircon near Green Cove Springs, Fla. Monazite output, which declined in 1974, was adversely affected by mining difficulties and production losses caused by the commissioning of a new heavier dredge.

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[1] Physical scientist. Division of Nonferrous Metals.

[2] Molycorp Inc. 1974 Annual Report. Mar. 3, 1975, 12 pp.

Monazite production by Humphreys Mining Co. also decreased in 1974 owing to the exhaustion of ore reserves at midyear at its beach sand deposit near Folkston, Ga. The company moved its dredging operation to a new beach sand deposit in Florida, a few miles south of the former deposit. Production at the new deposit began in November. The heavy mineral concentrate was trucked to the existing Folkston plant for processing.

Ethyl Corp. conducted tests to determine the feasibility of mining and recovering heavy minerals, including monazite, from the McNairy Formation near Paris Landing, Tenn. The company, which reportedly has about 2,000 acres under lease, planned to mine the formation by dredging methods if the tests were successful.[3]

Compounds and Metals.—Molycorp and the Davison Div. of W. R. Grace & Co., Chattanooga, Tenn., were the only volume processors and producers of rare-earth compounds in 1974. Molycorp, with processing plants at Mountain Pass, Calif., Louviers, Colo., and York, Pa., continued to be the principal domestic producer. Production was up slightly over that of 1973, and sales, including concentrates, were a record $23.1 million. The company completed expansion of chemical processing facilities at the Louviers and York plants in 1974 and expected to complete further additions to the milling and processing facilities at Mountain Pass in 1975.

High-purity rare-earth oxides and compounds were produced by Molycorp; Davison; Research Chemicals Div., Nucor Corp., Phoenix, Ariz.; Atomergic Chemetals Co., Div. of Gallard-Schlesinger Chemical Manufacturing Corp., Carle Place, N.Y.; and Transelco Inc., Penn Yan, N.Y. Molycorp, Research Chemicals, and Atomergic produced yttrium oxide and/or metal during the year. Significant quantities of high-purity rare-earth compounds were also sold during 1974 from the stocks of two former rare earth processors—the Lindsay Rare Earths Div. of Kerr-McGee Corp., West Chicago, Ill., and Michigan Chemical Corp., St. Louis, Mich.

Mischmetal was produced by Ronson Metals Corp., Newark, N.J., and Reaction Metals Inc., West Pittsburgh, Pa., a subsidiary of Rare Earth Industries. Ronson increased its production capacity in 1974 by adding additional electrowinning cells of new design. Mischmetal shipments increased slightly over those of 1973; however, production decreased.

REMCOA, owned 51% by Aluminum Co. of America (Alcoa) and 49% by Molycorp, successfully completed pilot electrolytic cell tests to produce rare-earth metals from bastnaesite concentrate. REMCOA planned to construct a 20,000-ampere production demonstration unit with a 125-ton annual capacity at Alcoa's Arnold, Pa., research facility. Additional production cells were planned for 1976 at a location to be determined.

Rare-earth ferrosilicon alloys, consumed primarily by the iron and steel industry in the United States and Canada, were produced by four companies: Foote Mineral Company, Ohio Ferro-Alloys Corp., American Metallurgical Products Co., Inc., and Union Carbide Corp. Production and shipments were considerably higher than in 1973.

Raytheon Co., Waltham, Mass., expanded its rare earth-cobalt magnet production facilities by installing a large, high-volume sintering furnace.[4] In 1974 the company marketed two new magnet materials, samarium-praseodymium-cobalt and mischmetal-cobalt. Other domestic producers of rare earth-cobalt magnets were Crucible Magnetics Div. of Colt Industries Inc., Elizabethtown, Ky.; Spectra-Flux Corp., Watsonville, Calif.; Electron-Energy Corp., Landisville, Pa.; and Hitachi Magnetics Corp., Edmore, Mich.

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[3] U.S. Bureau of Mines. State Liaison Officers News Bulletin. July 1974, p. 44.

[4] American Metal Market. Raytheon Installs Sintering Furnace To Make Rare-Earth Cobalt Magnets. V. 81, No. 45, Mar. 6, 1974, p. 5.

CONSUMPTION AND USES

Domestic rare-earth processors consumed an estimated 18,200 tons of REO contained in mineral concentrate in 1974 Bastnaesite consumption increased almost 7%, whereas monazite consumption decreased about 20%. Shipments of rare-earth and yttrium products from processing plants to domestic end use consumers were about 10,500 tons (in terms of REO), valued at about $26 million.

The approximate quantitative percentage distribution of rare-earth and yttrium consumption by end use, based on information supplied by primary processors and certain consumers, was as follows: Petroleum cracking catalysts, 44%; metallurgical, including nodular iron and steel, other alloys and mischmetal, 34%; ceramics and glass, 17%; and miscellaneous, including electrical, arc carbons, and research, 5%. Shipments of high-purity rare-earth and yttrium oxides and metals, although representing less than 1% of the total weight of shipments, accounted for about 25% of value shipped.

The manufacture of petroleum-cracking catalysts containing rare-earth zeolite as the active compound continued to be the largest use. Metallurgical usage remained at the 1973 level although certain applications, such as in ductile iron, continued to increase rapidly. The decline in automobile production in 1974 reduced rare-earth usage in the production of high-strength, low-alloy (HSLA) sheet and slowed research and development of HSLA alloys by the automotive industry. Mischmetal and rare-earth silicides were the forms most commonly used to add rare earths to ductile iron and steel. The rare earths promote ductility, improve impact and yield strength and formability, and are useful for the deoxidation and desulfurization of continuously cast and HSLA steel.

The production of lighter and striker flints continued to be a major consumer of mischmetal. Other rare-earth alloys and metals were used in the production of high-temperature alloys and superalloys and nuclear reactor control rods.

Besides the well-known use of cerium oxide for polishing plate glass, eyeglasses, television tubes, and camera lenses, a major and increasing use worldwide of cerium oxide was as a decolorizing agent in refining clear glass. Other rare-earth oxides—praseodymium, erbium, holmium, and neodymium—exhibit strong absorption of light and were used as colorants in glass. Lanthanum oxide increases the refractive quality of camera lenses.

Yttrium oxide and europium oxide were important phosphor materials in color television tubes. Terbium-activated gadolinium or lanthanum oxysulfide phosphors are increasingly used to intensify X-ray images; patients receive less X-ray dosage and images are brighter. Crystals of yttrium (or gadolinium)-aluminium (or iron) garnet (YAG) were used as microwave filters and control devices. The garnets, when doped with small quantities of neodymium or erbium, were used as lasers. YAG crystals have the appearance of diamond and are used as gem stones.

Rare-earth oxides and fluorides added to carbon arc electrodes emit a brilliant white light that is necessary for searchlights and for color motion picture photography and projection.

High-energy permanent magnets composed of rare earth-cobalt alloys consumed an estimated 5,000 pounds of rare earths, mostly samarium and mischmetal, in 1974. These magnets, which are two to three times more powerful than previous compositions, were used mainly in electric wristwatches, traveling wave tubes, and small electric motors and generators.

STOCKS

Bastnaesite concentrate stocks held by the principal producer and five other chemical processors at yearend increased 140%; monazite concentrate held by the two producers and two processing companies increased about 13%. Mischmetal stocks held by two principal producers and stocks of high-purity metals held by three firms remained at the 1973 level.

PRICES

Prices for domestic monazite remained stable during the year, whereas prices of foreign-produced monazite rose about 6% because of continued strong demand and reduced production. The average price per metric ton of Australian monazite (minimum 60% REO plus ThO_2), quoted in Metal Bulletin (London), increased from $200 f.o.b. and $215 c.i.f. at midyear to $215 and $228, respectively. The declared value of imported monazite concentrate from Malaysia and Thailand averaged $152 per short ton in 1974, 26% higher than in 1973. Malaysian xenotime concentrate with a minimum of 25% yttrium oxide content, as quoted in Industrial Minerals (London), remained unchanged at $3 to $5 per pound.

Unleached, leached, and calcined bastnaesite containing 55% to 60%, 68% to 72%, and 85% to 90% REO increased about 5 cents per pound REO in 1974 to 36, 41, and 48 cents, respectively, f.o.b. Mountain Pass or Nipton, Calif., in 100-pound paper bags or 55-gallon steel drums in truckload or carload lots.

Rare-earth oxide compound prices, in a downtrend since 1965, increased in 1974; further price increases were expected on many items in 1975, owing to price hikes for concentrates and higher processing costs. Prices per pound f.o.b. plant, for certain rare-earth compounds, also increased significantly; quoted prices at yearend were as follows: Mixed rare-earth oxides, 97% REO, $1.75 under 500 pounds decreasing to $1.45 for lots over 5 tons; chlorides, $0.45; carbonates, $1.15; fluorides, 84% REO, $1.27; and lanthanum-RE hydrate, $0.48.

Prices for optical-grade ceric oxide in lot sizes of 50 pounds or more delivered in bags or drums were at $2.25 per pound, up 25 cents. Quotations on cerium hydrate, 90% CeO_2 of total REO, increased from $1.50 per pound to $2, whereas 95% to 98% CeO_2 cerium hydrate rose 50 cents per pound to $2.05.

Quoted prices on 1-pound ingots in 50- to 100-pound lots of 97% didymium and cerium-free mischmetal remained at $15 and $5, respectively, f.o.b. plant. Mischmetal 99.8%, was quoted at $3.25 per pound, same basis. Ferrosilicon, containing 30% rare-earth metal, was quoted at $2.15 per pound (contained rare-earth metal). Rare earths for magnet use, 99% purity in 10- to 100-pound amounts, as quoted in American Metal Market were as follows, per pound: Cerium, $18; lanthanum, $27.50; praseodymium, $62.50; and samarium, $75.

Table 1.—Prices of high-purity oxides, salts, and metals in 1974[1]

(Dollars per pound)

Element	Oxide[2]	Salts[3]	Metal[4]
Cerium	[5] 6.50	12.00	50.00
Dysprosium	40.00	27.00	130.00
Erbium	45.00	27.00	160.00
Europium	[5] 515.00	225.00	3,000.00
Gadolinium	[5] 50.00	26.00	220.00
Holmium	120.00	80.00	300.00
Lanthanum	[5] 5.00	12.00	50.00
Lutetium	2,000.00	1,100.00	6,000.00
Neodymium	[5] 18.00	12.00	110.00
Praseodymium	32.00	16.00	170.00
Samarium	32.00	16.00	155.00
Terbium	[5] 350.00	175.00	[5] 845.00
Thulium	1,000.00	550.00	2,600.00
Ytterbium	85.00	70.00	240.00
Yttrium	30.00	15.00	150.00

[1] Research Chemicals, Nucor Corp., f.o.b. Phoenix, Ariz. Other producers may have different prices on some items.

[2] Minimum 99.9% purity, more than 1 pound.

[3] Minimum 99.9% purity, more than 1 pound; includes chlorides, nitrates, sulfates, oxalates, and acetates.

[4] Minimum 1 pound, ingot form.

[5] Price increased over that of 1973.

FOREIGN TRADE

According to the sole domestic producer, Molycorp, exports of bastnaesite concentrate were about 4,700 tons contained REO, slightly lower than those of 1973.

Exports of ferrocerium and other pyrophoric alloys to Sweden, Canada, Thailand, Australia, and 24 other countries increased 75%, totaling 192,144 pounds valued at $503,226. The average unit value of $2.62 per pound was up slightly over that of 1973.

Exports of compounds and mixtures of rare-earth metals, including yttrium and scandium, increased from 4,047,741 pounds valued at $4,592,374 in 1973 to 4,987,799 pounds valued at $6,644,533 in 1974. The large increase in value was due mainly to shipments of higher priced rare-earth compounds to West Germany and Italy.

Imports of monazite decreased substantially from those of 1973, although shipments from Thailand tripled, reaching 336 tons in 1974.

Cerium oxide imports, predominately from West Germany and France, totaled 31,390 pounds, valued at $100,977, compared with 11,716 pounds, valued at $22,826, in 1973. Other cerium compounds, n.s.p.f., mainly from France and Austria totaled 35,402 pounds, valued at $73,736, a 114% increase in quantity, but had the same unit value as in 1973.

Table 2.—U.S. imports for consumption of monazite, by country

Country	1970		1971		1972		1973		1974	
	Quantity (short tons)	Value (thousands)	Quantity (short tons)	Value (thousands)	Quantity (short tons)	Value (thousands)	Quantity (short tons)	Value (thousands)	Quantity (short tons)	Value (thousands)
Australia	1,977	$251	1,802	$219	--	--	--	--	--	--
Hong Kong	--	--	--	--	--	--	--	--	--	--
Malaysia	1,307	157	1,571	165	894	$89	1,991	$244	984	$154
Thailand	164	19	--	--	--	--	110	10	336	47
Total	3.448	427	3,373	384	894	89	2.101	254	1,320	201
REO content [e]	1,896	XX	1,855	XX	492	XX	1,156	XX	726	XX

[e] Estimate. XX Not applicable.

Table 3.—U.S. imports for consumption of rare-earth metals

(Including scandium and yttrium)

Country	1972		1973		1974	
	Pounds	Value	Pounds	Value	Pounds	Value
Germany, West	--	--	531	$4,322	641	$27,827
Japan	2,465	$5,585	--	--	--	--
Mexico	--	--	--	--	112	2,331
Norway	22	535	--	--	--	--
U.S.S.R.	2,650	51,870	11,446	200,349	7,785	157.957
United Kingdom	23	7.957	7	5,655	4	5,235
Total	5,160	65.947	11,984	210,326	8,542	193,350

Imports of rare-earth metals decreased 29% to 8,542 pounds in 1974, but the value of metal imports fell only 8%, owing mainly to higher prices.

Imports of ferrocerium and other pyrophoric alloys increased to 57,519 pounds, valued at $238,110, compared with 1973 receipts of 38,206 pounds, valued at $126,631. France supplied 73% of total shipments, valued at $165,901, followed by Japan with 23%, valued at $54,453. Other suppliers were the United Kingdom, Austria, and Singapore. No mischmetal was imported during 1974.

The tariffs on rare-earth metals and compounds were the same as in 1973. The tariff was 15% ad valorem on cerium oxide and chloride, $0.50 per pound on rare-earth alloys and mischmetal, $0.50 per pound plus 6% ad valorem on ferrocerium and other pyrophoric alloys, and 5% ad valorem on rare-earth metals and yttrium. Rare-earth ores and concentrates remained duty-free.

WORLD REVIEW

Australia.—Production of monazite continued to decline owing to leaner monazite contents in the ore, rising costs, and plant problems. According to the Rutile & Zircon Development Assoc., Ltd., monazite production by member companies, in short tons, in 1974 was as follows:

State	1972	1973	1974
New South Wales	1,604	1,076	1,071
Queensland	121	64	30
Western Australia	3,056	3,087	2,550
Total	4,781	4,227	3,651

Mary Kathleen Uranium Ltd. planned to construct a large-scale pilot plant early in 1976 to extract rare earths during the processing of its uranium ores. Commercial rare-earth production, having a value of about $4 million annually, was expected in 2 or 3 years, depending on the outcome of pilot tests.

Table 4.—Monazite concentrate: World production, by country
(Short tons)

Country [1]	1972	1973	1974 [p]
Australia	[r] 5,680	4,725	[e] 4,000
Brazil	[r] 2,303	1,606	[e] 1,650
India	4,504	3,858	[e] 3,300
Malaysia [2]	1,927	[e] 2,200	[e] 2,200
Mauritania [e]	110	110	110
Nigeria	11	6	[e] 6
Sri Lanka [e]	10	10	10
Thailand	188	351	[e] 390
United States	W	W	W
Zaire	251	250	[e] 250
Total	[r] 14,984	13,116	11,916

[e] Estimate [p] Preliminary. [r] Revised. W Withheld to avoid disclosing individual company confidential data.

[1] In addition to the countries listed, Indonesia and North Korea produce monazite, but available information is inadequate to make reliable estimates of output levels.

[2] Exports.

Brazil.—Mineral Deposits Ltd., an Australian firm, and the Comissão Nacional de Energia Nuclear, the Government nuclear authority, planned a joint exploration venture to prospect for heavy mineral sands in Brazil. If deposits are located, a joint company was to be established to mine and market ilmenite, rutile, zircon, and monazite.[5]

Canada.—In 1974, Denison Mines, Ltd., which resumed recovery of yttrium from waste uranium liquors in 1973, produced 86,788 pounds of yttrium oxide in a yttrium-rare earth concentrate. The entire production was exported.

Finland.—Kemira Oy was exploring a large rare-earth (0.4%) fluorapatite deposit as possible feed for the fertilizer complex at Siilinjarvi, in east-central Finland. A decision to go ahead with the project, including whether or not to recover rare earths, was expected in 1976 with full production by 1978.[6]

India.—India Rare Earths Ltd. (IRE), the state-owned company that mines and processes domestic monazite, planned to construct a rare-earth plant to process monazite at Gopalpur in Orissa, northeast India. The new capacity will be in addition to that at IRE's Alwaye plant in Kerala State.[7]

Malawi.—Lonrho Ltd. established a pilot plant to evaluate and beneficiate monazite and strontianite deposits at Kangankunde Hill. The deposit has inferred reserves of more than 15,000 tons of low-thorium monazite.

Malaysia.—Malaysian Rare Earth Corp. (MRE), a joint venture of Mitsubishi Chemical Ltd. and Reh Minerals Ltd., has been formed to process xenotime extracted from tin tailings. MRE anticipates that the operation will account for about half the world demand for yttrium when completed.

Norway.—In June, A/S Megon & Co. began full production of high-purity yttrium oxide at new facilities at Kjeller. The plant has a capacity of 30 to 50 tons per year and is designed to produce purities of 99.99999% Y_2O_3. Production has come from imported xenotime and byproduct concentrates from rare-earth processing plants in Japan and the United Kingdom, but by mid-1975, the plant was scheduled to use only Malaysian and Australian xenotime. To assure supplies, Megon was participating in a joint venture with Malaysian interests to construct and operate a 30-ton-per-year xenotime concentration plant near Kuala Lampur.[8]

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[5] Mining Journal (London). Australian/Brazilian Beach Sands Search. V. 282, No. 7238, May 10, 1974, p. 375.

[6] Industrial Minerals. Acids, Chemicals and Fertilizers in Kemira Oy Hands. No. 87, December 1974, p. 43.

[7] Industrial Minerals. A New REO Plant at Gopalpur. No. 86, November 1974, p. 26.

Sri Lanka.—A survey of the Pulmoddai beach-sand deposit by the Sri Lanka Geological Survey Department has established reserves of more than 3.2 million tons of heavy minerals sands, of which about 0.4% is monazite.[9]

TECHNOLOGY

The hydrogen-storage ability of lanthanum-nickel ($LaNi_5$) intermetallic alloy attracted considerable attention in 1974 because of the potential use of hydrogen as an alternate energy source. Because the alloy can absorb hydrogen at about twice the density of liquid hydrogen in one-third the space, uses in powerplant load-leveling systems, industrial supply, and automobiles were being considered.[10] Possible nonfuel uses based on hydrogen desorption and absorption factors include compressors and nickel-hydrogen batteries[11] and controllable home-heating sources using solar energy.[12]

The Bureau of Mines was investigating the hydrogen absorption characteristics of mischmetal and other rare-earth metals, nickel, and cobalt intermetallics. Preliminary results indicate that, of the alloys tested, only $LaNi_5$ and $LaCo_5$ exhibited significant absorption characteristics.

Rare-earth β-diketoenolates were tested as antiknock agents in motor fuels.[13] Preliminary results indicated they were as effective or better than tetraethyl lead in some applications. In addition, combustion products of the additive were effective in reducing noxious hydrocarbon emissions.

More efficient removal of objectional organic emissions in certain chemical processes, including automobile exhaust systems, using a new family of $LaCoO_3$ catalysts may be possible.[14] The catalystic properties of the compound can be modified by replacing a fraction of the lanthanum and zirconium, tin, or thorium to alter structural defects. Researchers at Bell Laboratories are using similar methods to modify the properties of rare earth-lead manganites, also a potential automotive exhaust catalyst.

Laser fusion technology was advanced when Battelle Columbus Laboratories produced 1,400 joules of laser energy in a 3.5-nanosecond pulse using a 12-beam, neodymium-doped glass laser that has an overall potential of 2,500 to 3,000 joules.[15] The experimental results indicated that a short-pulsed laser with an energy greater than one kilojoule can be constructed and used for laser plasma studies without causing damage to the system or premature target destruction. One report indicated that a demonstration laser fusion power reactor might be on-line by the mid-1990's.[16]

Research on rare-earth additives in steelmaking continued to be directed toward improving addition techniques to control sulfide shape.[17] In another study, prediction of the behavior of rare-earth elements in steel by using available thermodynamic and phase equilibria data was discussed.[18]

A rare-earth, ferroelectric ceramic (7% lanthanum in lead titanite) developed by Sandia Laboratories may boost computer holography by improving image storage. When light is projected through a photographic negative and voltage is applied, the ceramic deforms into thousands of retrievable microscopic depressions that are related to the light intensity.

The addition of small amounts of yttrium to such superalloys as Fe-Cr and

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[8] Industrial Minerals. Norway's Industrial Minerals. No. 88, January 1975, p. 41.

[9] Industrial Minerals. Pulmoddai's Mineral Sands. No. 77, February 1974, p. 27.

[10] Billings, R. E. Hydrogen Storage in Automobiles Using Cryogenics and Metal Hydrides. The-Hydrogen-Economy Miami Energy (THEME) Conf. Proc., Miami Beach, Fla. Mar. 18–20, 1974, Sec. S8, pp. 51–61.

[11] Buschow, K. H. J., F. A. Kuijpers, A. R. Miedema, and H. H. vanMal. Hydrogen in Rare Earth Intermetallics. Proc. 11th Rare-Earth Res. Conf. U.S. Atomic Energy Comm., Traverse City, Mich., Oct. 7–10, 1974, pp. 417–429, available from National Technical Information Services, Springfield, Va.

[12] Energy and Mineral Resources Research Institute, Iowa State University (Ames, Iowa). Energetic Hydride. Rare-Earth Inf. Center News, v. 9, No. 4, Dec. 1, 1974, p. 3.

[13] Chemical and Engineering News. Rare Earths Show Promise as Antiknocks. V. 52, No. 12, Mar. 25, 1974, pp. 27–28.

[14] Industrial Research. Oxidation-Reduction Catalysts Improved. V. 17, No. 1. January 1975, p. 15.

[15] Chemical and Engineering News. V. 52, No. 47, Nov. 25, 1974, p. 16.

[16] Chemical and Engineering News. Industry Seeks a Role in Fusion Power. V. 52, No. 41, Oct. 14, 1974, pp. 8, 10.

[17] Bennett, H. W., and L. P. Sandell, Jr. Rare Earth Additions to Electric Furnaces for Sulfide Shape Control. J. Metals, v. 26, No. 2, February 1974, pp. 21–24.

[18] Wilson, W. G., D. A. R. Kay, and A. Vahed. The Use of Thermodynamics and Phase Equilibria to Predict the Behavior of the Rare Earth Elements in Steel. J. Metals, v. 26, No. 5, May 1974, pp. 14–23.

Ni-Cr increases oxidation resistance and operating temperature. Several new alloys for use in jet engines and in high-temperature gas turbines were reported.[19] In another development, an improved Ni-Cr-Al-Y alloy was designed for use as a protective coating on turbine blades.[20] The alloy, which is vapor deposited, provides better oxidation and corrosion resistance than aluminide coatings and lasts about 4 times longer.

The Eleventh Rare Earth Research Conference was held at Traverse City, Mich., in October. The program covered all phases of current rare-earth research and development and included sessions on bi-organic chemistry, coordination chemistry, magnetics, metal physics and metallurgy, solid state science, spectroscopy, and industrial applications.[21]

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[19] American Metal Market. Hi-Temp Demand at Stellite 35% Ahead of Last Year's Pace. V. 81, No. 129, July 3, 1974, pp. 1A, 7A.

———. Inco Lab's Mechanical Nickel Alloy Tested for Jets, Arouses Wide Interest. V. 81, No. 61, Mar. 28, 1974, pp. 1, 20.

[20] Metal Progress. Turbine Component Life Extended by New Alloy. V. 106, No. 5, October 1974, pp. 7, 10.

[21] Haschke, J. M., and H. A. Eick (eds.). Proceedings of the 11th Rare Earth Research Conference, Oct. 7-10, 1974, Traverse City, Mich. Conf-741002-P2, 1974, 1138 pp.; available from National Technical Information Service, Springfield, Va.

Rhenium

By Larry J. Alverson [1]

Domestic rhenium production decreased in 1974 but was more than adequate to meet the slightly increased demand from all end use sectors. The prices for rhenium and its compounds continued to decline but at a less rapid pace than in previous years; stocks continued to increase. Imports of metal declined precipitously while imports of ammonium perrhenate increased slightly, resulting in an overall decrease in total rhenium imports of about 25%. Bimetallic platinum-rhenium catalysts used in petroleum refining continued to represent the major use for rhenium in this country and worldwide.

Table 1.—Salient rhenium statistics
(Pounds of contained rhenium)

	1970	1971	1972	1973	1974
Mine production [e]	5,900	7,250	6,100	7,000	6,700
Consumption [e]	5,100	7,600	4,800	4,400	4,500
Imports (metal and scrap)	210	877	168	1,437	40
Imports (ammonium perrhenate)[e]	825	3,435	[r] 1,921	3,040	3,287
Stocks, Dec. 31 [e]	6,200	9,700	13,000	20,000	26,000

[e] Estimate. [r] Revised.

DOMESTIC PRODUCTION

Production of rhenium, a byproduct recovered primarily from molybdenite (MoS_2) associated with southwestern United States, Chilean and Canadian porphyry copper ores, decreased in 1974 to an estimated 6,700 pounds, contained in ammonium perrhenate. Cleveland Refractory Metals (CRM), a subsidiary of Kennecott Copper Corp., continued to be the leading rhenium producer in the United States. CRM processed domestic MoS_2 concentrate from operations of Kennecott and Magma Copper Co., as well as concentrates from Chilean and other domestic sources, at its Garfield, Utah, roasting facility.

M&R Refractory Metals, Inc., at its Winslow, N.J., plant produced rhenium salts for Engelhard Minerals & Chemicals Corp. on a "toll" or contract conversion basis, from MoS_2 recovered at Magma's San Manuel porphyry copper mine. Shattuck Chemical Co., Denver, Colo., a division of Engelhard Minerals & Chemicals Corp., recovered rhenium salts from Arizona molybdenite concentrate. Molybdenum Corp. of America recovered rhenium salts from MoS_2 concentrate from Arizona porphyry copper ores and primary molybdenite from the Questa molybdenum mine in New Mexico.

Newmont Exploration Ltd., a subsidiary of Newmont Mining Corp., continued its investigations into a method for the economical recovery of rhenium from Magma Copper Co.'s Arizona molybdenite concentrates.

Porphyry copper deposits in Canada, Chile, Peru, the United States, and the U.S.S.R. are the major or potential worldwide sources of rhenium. Rhenium recovery facilities outside of the U.S. exist in Chile, Belgium, Bulgaria, France, Sweden, the United Kingdom, the

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[1] Industry economist, Division of Ferrous Metals.

U.S.S.R., and East and West Germany. The United States operated at about 50% of rhenium production capacity in 1974.

CONSUMPTION AND USES

Approximately 75% of the estimated 1974 rhenium consumption of 4,500 pounds was used in bimetallic platinum-rhenium catalysts for refining low-lead and no-lead high-octane gasoline. Bimetallic catalysts continued to capture more catalytic-reforming capacity in semi-regenerative, cyclic, and other reformers, with platinum-rhenium catalysts representing an important part of this activity. About 44% of this country's reforming capacity is accounted for by bimetallic catalysts, compared with 30% just 3 years ago.[3] Platinum-rhenium's percentage has grown also, and now stands at about 60% to 70% of total bimetallic catalyst capacity, or 25% to 30% of total domestic reforming capacity.

Older refineries continued to make conversions from straight platinum catalysts to bimetallic ones, such as platinum-rhenium catalysts. This, in conjunction with new reformers added in 1974, brought the net additional reforming capacity to 164,000 barrels per day. The Arkansas City, Kans., refinery of Apco Oil Corp. was increasing its catalytic reforming capacity by 10,000 barrels per day and was to employ Universal Oil Products Co.'s R–16G platinum-rhenium catalyst. Completion was expected in the summer of 1975. Standard Oil Co. of California (SOCAL) planned to complete another 25,000-barrel-per-day Rheniformer at its Richmond, Calif., refinery by late 1975. SOCAL is also installing 25,000-barrel-per-day Rheniformers at its Perth Amboy, N.J., and Pascagoula, Miss., refineries. The California and New Jersey units will have two stages while the Mississippi unit will have a single stage. Each of these units will use 400 to 500 pounds of rhenium.

The remaining 25% of estimated domestic rhenium consumption was in high-temperature thermocouples, electronic devices, X-ray tubes and targets, electrical contacts, vacuum tube and flashbulb filaments, heating elements, metallic coatings, and electromagnets.

Rhenium is being evaluated as an alloying material with nickel for use in jet engine turbine blades. If this use proves successful, it would provide a substantial new outlet for the depressed rhenium market. Tungsten-rhenium thermocouples experienced an increase in demand during 1974. One such thermocouple, tungsten-3% rhenium versus tungsten-25% rhenium, with proper insulating materials, is used continuously to 2,400°C and intermittently as bare wire up to 2,800°C for temperature measurement in clean inert atmospheres, hydrogen, vacuum, and nuclear environments.

PRICES

The price for rhenium metal powder during the year ranged from about $675 to $625 per pound, depending on quantity, decreasing toward $625 by yearend. The price for perrhenic acid, a starting material in catalytic applications, ranged from about $625 to $600 per pound, depending on quantity, trending toward $600 in the second half of the year. These price decreases reflected the soft nature of the domestic rhenium market, due principally to the lack of new reforming units that utilize platinum-rhenium catalysts.

FOREIGN TRADE

Imports for consumption of unwrought rhenium metal powder, waste, and scrap dropped precipitously during 1974, totaling only 40 pounds valued at $27,734. The imported unwrought rhenium metal was recovered in the supplying country from byproduct molybdenite believed to have come from porphyry copper ores mined in Canada, Chile, and Peru. The average price of the metal imports was $693 per pound, all coming from West Germany.

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[3] The Oil and Gas Journal. Building by Small Refiners Boosts U.S. Refining Total. V. 73, No. 12, Mar. 24, 1975, pp. 13–16.

Estimated imports of ammonium perrhenate (NH_4ReO_4), from Chile, Sweden, and West Germany increased 8% during the year to an estimated 3,287 pounds of contained rhenium valued at $1,805,000. Substantial quantities of ammonium perrhenate totaling an estimated 1,842 pounds of contained rhenium valued at $1,066,066 were also imported from Chile into bonded warehouses during 1974. This material was purchased in compliance with an existing long-term contract, and was imported under the basket classification "Ammonium compounds, not specifically provided for (TSUS 417.44)."

Table 2.—U.S. imports for consumption of rhenium metal [1] (including scrap), by country

(Gross weight)

Country	1970		1971		1972		1973		1974	
	Quantity (pounds)	Value	Quantity (pounds)	Value	Quantity (pounds)	Value	Quantity (pounds)	Value	Quantity (pounds)	Value
Belgium-Luxembourg	--	--	220	$262,278	--	--	110	$74,500	--	--
France	58	$53,789	45	49,770	25	$23,796	--	--	--	--
Germany, West	79	34,373	110	140,000	143	101,955	1,116	782,497	40	$27,734
Netherlands [2]	--	--	--	--	--	--	211	147,679	--	--
United Kingdom	--	--	2	794	--	--	--	--	--	--
U.S.S.R	73	23,467	--	--	--	--	--	--	--	--
Total	210	111,629	377	452,842	168	125,751	1,437	1,004,676	40	27,734

[1] 1,786 pounds valued at $448,931 was reported to the Bureau of Mines in 1974 as rhenium metal from Chile, but was actually ammonium perrhenate with a rhenium content of 1,232 pounds. The 1,232 pounds was entered in table 3 with other ammonium perrhenate imports. The totals have been adjusted by the Bureau of Mines to reflect a more accurate picture of rhenium imports in 1974.

[2] Data being checked by Bureau of Mines.

Table 3.—Estimated imports for consumption of ammonium perrhenate, by country [1]

(Rhenium content)

Country	1970		1971		1972		1973		1974	
	Quantity (pounds)	Value (thousands)	Quantity (pounds)	Value (thousands)	Quantity (pounds)	Value (thousands)	Quantity (pounds)	Value (thousands)	Quantity (pounds)	Value (thousands)
Chile	--	--	--	--	76	$45	--	--	[2] 1,232	[2] $449
Germany, West	115	$115	1,395	$1,545	845	1,054	1,450	$1,913	1,520	1,185
Sweden	710	659	2,040	2,202	1,000	1,189	1,590	1,916	535	171
Total	825	774	3,435	3,747	r 1,921	r 2,288	3,040	3,829	3,287	1,805

r Revised.

[1] Figures are derived from the basket category "Ammonium compounds not specifically provided for (TSUS 417.44)."

[2] The 1,786 pounds reported to the Bureau of Mines as rhenium metal was actually ammonium perrhenate having a rhenium content of 1,232 pounds. The 1,232 pounds was entered in this table with other ammonium perrhenate imports. The totals have been adjusted by the Bureau of Mines to reflect a more accurate picture of rhenium imports in 1974.

The import duty on rhenium from countries with market economies remained at the January 1, 1972 rate of 5% ad valorem for unwrought rhenium metal, and 9% ad valorem for wrought rhenium metal. The duty on wrought and unwrought rhenium metal from countries with centrally controlled economies also remained unchanged at 45% and 25% ad valorem, respectively. The duty on imports of ammonium perrhenate from countries with market economies was 4% ad valorem, and that from countries with centrally controlled economies was 25% ad valorem. The duty on rhenium waste and scrap was suspended until June 30, 1975.

WORLD REVIEW

Canada.—The Island Copper Mine of Utah International, Inc. (UI), near Port Hardy, British Columbia, contains one of the richest concentrations of rhenium in the world. Shipments have steadily increased since inception of the operation in 1972, when shipments of molybdenite concentrate to U.S. and Western European refineries totaled 400 tons containing about 1,200 pounds of rhenium. In 1973, shipments totaled about 1,200 tons containing approximately 3,200 pounds of rhenium; 1974 shipments totaled about 1,500 tons containing approximately 3,700 pounds of rhenium. Molybdenite purchasers have either paid for the contained rhenium or recovered the rhenium on a toll basis and returned it to UI.

Chile.—The proposed rhenium recovery plant of Cía. de Acero del Pacífico S.A. (CAP) at Concepcíon is still in the initial proposal stage. However, there has been no work at the site for over a year, and due to lack of financing, the future of this facility is questionable.

The privately owned firm, Carburo y Metalurgia S.A. (Carbomet), continued to recover rhenium in the form of ammonium perrhenate for export, at its plant in Santiago. Capacity is about 2,700 pounds per year. Currently, Chile's total rhenium recovery capacity is about 3,600 pounds per year.

The rhenium content of Chilean MoS_2 in porphyry copper deposits runs from about 230 parts per million (ppm) at Chuquicamata to 570 ppm at El Salvador with varying degrees in between at other operations.[3]

Peru.—Rhenium reserves were estimated in a preliminary report at about 352 tons representing 19% of estimated world reserves of approximately 1,900 tons.[4] There is currently no rhenium production in Peru, yet about three-quarters of the Peruvian MoS_2 exported from the Toquepala copper operation to West Germany and Sweden is processed for the contained rhenium. The rhenium content of the MoS_2 averages over 300 ppm.

TECHNOLOGY

The Bureau of Mines was granted a patent on its process for recovering rhenium from solution. The process consists of (1) contacting the solution with an adsorbent consisting essentially of activated carbon to selectively absorb the rhenium and (2) eluting the adsorbed rhenium from the activated carbon by means of an eluant comprised of a water-soluble alcohol or a mixture of a water-soluble alcohol and water. Rhenium recovery in excess of 96% was achieved by the procedure.[5]

The Bureau continued its studies to develop improved, low-cost leaching processes for the economical recovery of copper and byproducts, such as rhenium, from ores, concentrates, and mine wastes.

Atomic absorption of rhenium using a neon analysis line was studied. It was determined that the rhenium detection limit is no more than an order of magnitude greater, and in some cases less, than those determined with rhenium hollow cathode lamps. Therefore, it was concluded that neon-filled hollow cathode lamps can be used for the practical atomic absorption analysis of rhenium.[6]

A cobalt-44 atomic percent rhenium amorphous alloy was formed by electrodeposition from a bath first developed in 1952. The fabrication of this new amorphous metal was significant in view of the current interest in these materials and the fact that few such alloys have been electrodeposited.[7]

The oxidation of columbium-rhenium single crystals in dry oxygen between 500°C and 1,000°C was studied. Rhenium additions reduced the oxidation rate of pure columbium but only at temperatures below 650°C; greater additions yielded a more marked reduction in the oxidation rate. In the oxidation of pure columbium, suboxide platelets, anisotropic scale-failures, and a transition to breakaway kinetics are only observed at temperatures below about 625°C. Rhenium additions effectively reduced the time to breakaway by at least two orders of magnitude. Rhenium additions also appear to reduce the dynamic stability of suboxide platelets and to produce unusual anisotropic scale-failures on oxidized single crystals. Rhenium seems to dissolve in Cb_2O_5 to produce a more "plastic" and adherent scale. At higher temperatures, the oxidation rates of the alloys approach that for pure columbium as rhenium is probably removed by the volatilization of Re_2O_7.[8]

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[3] Sutulov, A. Copper Porphyries. Miller Freeman Publications, Inc., San Francisco, Calif., 1974, 200 pp.

[4] World Mining. 8th World Mining Congress. V. 28, No. 1, January 1975, p. 36.

[5] Bauer, D. J., D. D. Fischer, and R. E. Lindstrom (assigned to U.S. Secretary of the Interior). Recovery of Rhenium. U.S. Pat. 3,862,292, Jan. 21, 1975.

[6] Lovett, R. J., and M. L. Parsons. Atomic Absorption of Rhenium Using a Neon Analysis Line. Anal. Chem., v. 46, No. 14, December 1974, pp. 2241–2242.

[7] Cote, P. J., G. P. Capsimalis, and V. P. Greco. Electrodeposition of an Amorphous Cobalt-Rhenium Alloy. J. Electrochem. Soc., v. 121, No. 6, June 1974, pp. 776–777.

Separation of rhenium (VII) from chromium, cobalt, copper, iridium, iron, manganese, molybdenum, nickel, ruthenium, tungsten, uranium, and vanadium was achieved by solvent extraction with 4-methyl-2 pentanol (methylisobutylcarbinol) either from sulfuric or hydrochloric acid media. The results are accurate to within ±0.5%, and the total single extraction operation requires less than 30 minutes.[9]

A paper dealing with the properties, occurrence, and extensively with the chemistry of rhenium compounds was published during the year. It is particularly interesting for its bibliography of 548 items.[10]

The Bureau was granted a patent on the extraction of molybdenum and rhenium values from molybdenite. The process consists of electrolyzing a slurry of finely divided ore and sodium chloride at a temperature of preferably 30° to 50°C and a pH of from 5.5 to 6.5 in a bipolar flow-through cell, whereby the values are electrooxidized. A solution containing the values is separated from the gangue solids and subjected to conventional processing methods.[11]

Kennecott Copper Corp. received a patent on recovery of rhenium from industrial solutions. A solution obtained by scrubbing molybdenite roaster flue gas or a raffinate from ion exchange or solvent extraction is reacted with hydrogen sulfide or silicon sulfide in the presence of either iron, nickel, or zinc powder at a pH of from 0.5 to 3.5 to precipitate insoluble rhenium values. Subsequently the reaction mixture is filtered to recover the rhenium values.[12]

A patent was granted to PPG Industries, Inc., on the extraction of molybdenum and rhenium from molybdenite. Finely divided ore is contacted with an ammonium, a stable alkali metal, or alkaline earth metal, persulfate solution at a temperature of preferably 25° to 40°C, whereby a substantial proportion of the molybdenum is solubilized and dissolved along with copper and iron, whereas most of the rhenium remains in the undissolved residue. The leach solution is then separated and processed for molybdenum, and the solids, for rhenium.[13]

A recycle process was patented for the recovery of rhenium by solvent extraction from molybdate solutions. The organic extractant solution, stripped of most of its rhenium content, was blended with sufficient organic active extractant to attain essentially the same rhenium extraction efficiency that is achieved with a comparable extractant solution prior to initial contact with molybdate-rhenium solutions. Such recycling results in eventual recovery of a very high percentage of rhenium.[14]

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[8] Taylor, A., and J. Stringer. The Oxidation of Nb-Re and Nb-W Single Crystals and Polycrystals Between 500 and 1,000° C. J. of Less Common Metals, v. 39, No. 1, January 1975, pp. 109–141.

[9] Patil, S. P., and V. M. Shinde. A Fast Method for Extraction and Separation of Rhenium (VII). Separation Sci., v. 9, No. 3, 1974, pp. 249–255.

[10] Rouschias, G. Recent Advances in the Chemistry of Rhenium. Chem. Rev., v. 74, No. 5, 1974, pp. 531–566.

[11] Scheiner, B. J., R. E. Lindstrom, and T. A. Henrie (assigned to U.S. Secretary of the Interior). Electro-oxidative Method for the Recovery of Molybdenum From Sulfide Ores. U.S. Pat. 3,849,265, Nov. 19, 1974.

[12] Wright, C. N., and K. J. Richards (assigned to Kennecott Copper Corp., New York, N.Y.). Process for Recovering Rhenium Values From Complex Industrial Solutions. U.S. Pat. 3,870,779, Mar. 11, 1975.

[13] Carlin, W. W. (assigned to PPG Industries, Inc., Pittsburgh, Pa.). Opening of Molybdenite Ores. U.S. Pat. 3,816,588, June 11, 1974.

[14] Pagnozzi, L. R., T. K. Kim, J. M. Laferty, and M. B. MacInnis (assigned to GTE Sylvania, Inc., Stamford, Conn.). Solvent Recycle Process for Recovery of Rhenium From Molybdate Solutions. U.S. Pat. 3,856,915, Dec. 24, 1974.

Salt

By Charles L. Klingman [1]

In 1974 salt production returned to its previous growth rate of about 5% per year for the first time since 1970. Total production was 46,423,000 tons, compared with 44,298,000 tons in 1973. Statistics for salt sold or used showed rock salt leading the increase with a 20% gain over the quantity of rock salt sold or used in 1973. There were also small gains in vacuum-pan and open-pan salt, but solar salt and salt in brine remained relatively stable.

All salt prices advanced in 1974. The price of vacuum-pan salt averaged 18% higher than in 1973, probably because of the sharply rising cost of fuel needed for evaporation. By contrast, solar salt and salt in brine, which used very little fuel, advanced only 3% in average price. Rock salt prices increased about 15% over the 1973 prices.

Total salt sold or used by producers increased 2.8 million tons during the year, which included a 1.7-million-ton increase in highway use.

Legislation and Government Programs.—The Environmental Protection Agency (EPA) had significant influence on the production of several compounds made from salt through its regulation of the effluents from the plants. The sharp decline in synthetic (Solvay) soda ash output over the past 8 years has been due primarily to EPA restrictions on the amounts of allowable salt and calcium chloride permitted in streams, rivers, and lakes which receive the plant wastes. There have been five shutdowns of Solvay soda ash plants since 1966. Salt consumption for soda ash manufacture has dropped an average of 350,000 tons per year each year since 1966.

In 1974, announcements were made as to the possible carcinogenicity of vinyl chloride and the depletion of the ozone layer of the stratosphere by chlorofluorocarbons. Production of vinyl chloride and chlorofluorocarbons, both of which contain chlorine, was significantly reduced, and this in turn reduced the demand for salt to manufacture the chlorine.

In September 1974, the United Salt Corp. of Houston, Tex., was given approval by the U.S. Food and Drug Administration (FDA) to sell salt obtained as a byproduct of chlorine-caustic electrolysis for use as food-grade salt. The FDA action was challenged in the courts on the contention that such salt might contain harmful asbestos fibers. In April 1975, the FDA reversed its previous ruling and decertified this byproduct salt for use in food.[2] None of the byproduct salt was known to have been marketed.

The salt industry has traditionally enjoyed a 10% depletion allowance on its production, but this tax-reducing allowance was under study by Congress in 1974 and may be either reduced or eliminated.[3]

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[1] Physical scientist, Division of Nonmetallic Minerals.

[2] Washington Post. An FDA Switch on Salt. Apr. 8, 1975, p. B2.

[3] Chemical Marketing Reporter. Depletion Allowance Viewed by House W&M Panel: Gas, Potash, Salt, and Sulfur. V. 205, No. 17, May 6, 1974, p. 5.

Table 1.—Salient salt statistics

(Thousand short tons and thousand dollars)

	1970	1971	1972	1973	1974
United States:					
Production [1]	46,764	44,700	44,010	44,298	46,423
Sold or used by producers [1]	45,896	44,077	45,022	43,910	46,536
Value	$304,759	$303,687	$296,772	$306,103	$360,763
Exports	423	670	869	609	521
Value	$3,657	$4,182	$5,544	$4,400	$4,276
Imports for consumption	3,536	3,855	3,463	r 3,207	3,358
Value	$13,329	$14,429	$11,979	r $12,554	$14,428
Consumption, apparent	49,009	47,262	47,616	46,508	49,373
World: Production	161,081	159,107	r 161,350	r 166,611	172,228

r Revised.

[1] Excluding Puerto Rico. 32,000 short tons (1970), 28,500 short tons (1971), 29,000 short tons (1972, 1973, and 1974).

DOMESTIC PRODUCTION

Total salt sold or used in 1974 was about 6% higher than that of 1973; the largest gain occurred in rock salt, which had a 20% increase. There were also slight increases in vacuum-pan and open-pan evaporated salt sold or used.

The five leading States in the amount of salt sold or used are as follows, in descending order:

State	Percentage of total
Louisiana	29
Texas	24
New York	14
Ohio	11
Michigan	10
Total	88

In 1974 there were 95 salt-producing plants operated by 52 companies in 15 States and Puerto Rico. Twelve of these companies produced 88% of the total salt. The percentage of salt sold or used in 1974 by type is as follows:

	Percent
Salt in brine	55
Mined rock salt	32
Vacuum-pan salt	8
Solar-evaporated salt	4
Grainer or open-pan salt	1

An estimated 9,200 workers were employed by all of the salt companies, about 28% in mining and 72% in processing salt.

The International Salt Co.'s crystallizing plant in Cleveland, Ohio, was closed in February 1974 because the novel process was not competitive with existing vacuum-pan operations. The salt mine at this location continued to operate normally.

Table 2.—Salt sold or used by producers in the United States,[1] by method of recovery

(Thousand short tons and thousand dollars)

Recovery method	1973		1974	
	Quantity	Value	Quantity	Value
Evaporated:				
Bulk:				
Open pans or grainers	525	16,546	540	18,456
Vacuum pans	2,984	87,489	3,032	104,780
Solar	1,924	17,299	1,910	17,763
Pressed blocks	451	14,508	440	15,888
Total [2]	5,884	135,843	5,922	156,886
Rock:				
Bulk	12,275	75,993	14,753	105,383
Pressed blocks	72	2,551	82	3,308
Total [2]	12,347	78,544	14,835	108,692
Salt in brine (sold or used as such)	25,680	91,717	25,779	95,185
Grand total [2]	43,910	306,103	46,536	360,763

[1] Excludes Puerto Rico.

[2] Data may not add to totals shown because of independent rounding.

Table 3.—Salt sold or used by producers in the United States, by State

(Thousand short tons and thousand dollars)

State	1973		1974	
	Quantity	Value	Quantity	Value
California	1,507	15,533	W	W
Kansas [1]	1,397	23,460	1,367	27,007
Louisiana	13,152	66,211	13,543	76,960
Michigan	4,818	53,732	4,445	62,055
New Mexico	W	W	167	W
New York	5,202	42,364	6,464	57,705
Ohio	4,657	41,643	5,029	49,089
Oklahoma	5	36	W	W
Texas	10,354	45,350	11,379	51,296
Utah	717	6,913	771	7,321
West Virginia	1,217	6,082	1,201	6,296
Other States [2]	885	4,778	2,169	23,035
Total [3]	43,910	306,103	46,536	360,763
Puerto Rico	29	580	29	624

W Withheld to avoid disclosing individual company confidential data; included with "Other States."

[1] Quantity and value of brine included with "Other States."

[2] Includes Alabama, Colorado, Kansas (brine only), Nevada, North Dakota, and States indicated by symbol W.

[3] Data may not add to totals shown because of independent rounding.

Table 4.—Evaporated salt sold or used by producers in the United States

(Thousand short tons and thousand dollars)

State	1973		1974	
	Quantity	Value	Quantity	Value
California	1,246	14,594	W	W
Kansas	782	19,914	778	23,127
Louisiana	285	9,976	296	11,386
Michigan	1,129	33,359	1,244	42,127
New York	632	19,353	641	21,980
Ohio	777	W	W	W
Oklahoma	5	36	W	W
Other States [1]	1,028	38,612	2,963	58,265
Total [2]	5,884	135,843	5,922	156,886
Puerto Rico	29	580	29	624

W Withheld to avoid disclosing individual company confidential data; included in "Other States."

[1] Includes Nevada, New Mexico, North Dakota, Texas, Utah, and States indicated by symbol W.

[2] Data may not add to totals shown because of independent rounding.

Table 5.—Rock salt sold by producers in the United States

(Thousand short tons and thousand dollars)

Year	Quantity	Value
1970	14,170	95,291
1971	13,700	89,321
1972	14,434	91,041
1973	12,347	78,544
1974	14,835	108,692

Table 6.—Pressed-salt blocks sold by original producers of salt in the United States

(Thousand short tons and thousand dollars)

Year	From evaporated salt		From rock salt		Total	
	Quantity	Value	Quantity	Value	Quantity	Value
1970	368	10,085	79	2,269	447	[1] 12,353
1971	367	10,532	87	2,095	454	12,627
1972	376	10,927	66	2,138	442	13,065
1973	451	14,508	72	2,551	523	17,059
1974	440	15,888	82	3,308	522	19,196

[1] Data does not add to total shown because of independent rounding.

STOCKS

The 1974 Bureau of Mines survey obtained information for the first time on salt stocks on hand at yearend. Although the coverage was incomplete, it indicated that the total salt held by all producers was about 4.7 million tons, or 10% of the annual production. Over half of this tonnage was in the form of rock salt, and most of the remainder was solar salt. Solar salt had the highest percentage of its production in stocks. Rock salt stocks were about 17% of the annual production, and evaporated salt had only 3.5% of its annual production in stocks. The brine industry had very little inventory of salt on hand at yearend.

CONSUMPTION AND USES

Consumption of salt on highways showed a 28% gain over the 1973 tonnage because of more severe weather conditions. Use of salt for manufacturing chlorine increased nearly a half million tons. There were significant reductions in salt used by feed mixers and for soda ash manufacture, and there were smaller reductions in paper and pulp and in grocery store use.

In 1974 the United States imported 7% of its apparent salt consumption and exported about 1% of its production. Net imports (imports minus exports) were 2.8 million tons, 9% greater than net imports for 1973.

Production of chlorine and caustic soda continued to be the leading salt user in 1974 at 49% of the total, but the rate of usage for chlorine dropped considerably toward yearend. The amount of salt going to synthetic soda ash dropped in 1974 to 4.56 million tons, a 4.5% reduction from usage in 1973.

Table 7.—Distribution of salt sold or used by producers in the United States, by use

(Thousand short tons)

Consumer or use	1973				1974			
	Evaporated	Rock	Brine	Total [1]	Evaporated	Rock	Brine	Total [1]
Chlorine	W	W	20,052	22,598	338	2,215	20,527	23,080
Soda Ash	(²)	(³)	4,776	4,776	(³)	(³)	4,563	4,563
All other chemicals	W	850	W	1,402	W	1,170	W	1,734
Textile and dyeing	123	78	--	201	143	61	--	205
Meatpackers, tanners, casing manufacturers	247	330	--	577	262	329	--	591
Dairy	58	3	--	61	65	4	--	69
Canning	169	68	(³)	238	174	W	W	241
Baking	114	8	--	122	W	W	--	118
Flour processors (including cereal)	75	10	(³)	85	73	12	(³)	85
Other food processing	536	W	W	576	575	W	W	614
Feed dealers	880	490	(³)	1,370	1,010	501	--	1,512
Feed mixers	427	287	--	713	262	209	--	471
Metals	W	177	W	228	W	203	W	252
Rubber	W	W	W	166	W	W	W	157
Oil	52	61	101	215	66	56	120	242
Paper and pulp	W	120	W	209	W	84	W	165
Water softener manufacturers and service companies	338	W	W	687	341	W	W	835
Grocery stores	881	411	(³)	1,292	826	426	--	1,252
Highway use	327	5,751	(²)	6,079	W	7,451	W	7,757
U.S. Government	33	68	(³)	102	31	59	(³)	90
Distributors (brokers, wholesalers, etc.)	(³)	(³)	(³)	(³)	157	379	--	537
Miscellaneous [4]	1,645	3,312	1,067	[5] 2,227	1,568	1,439	989	[5] 2,120
Total [1]	[6] 5,905	[6] 12,024	[6] 25,996	[7] 43,924	[6] 5,893	[6] 14,599	[6] 26,199	[7] 46,691

W Withheld to avoid disclosing individual company confidential data; included with Miscellaneous.

[1] Data may not add to totals shown because of independent rounding.

[2] Less than ½ unit.

[3] Included with Miscellaneous.

[4] Includes withheld figures and some exports and consumption in overseas areas administered by the United States.

[5] Incomplete totals; withheld totals are included with total for each specific use.

[6] Differs from totals shown in tables 2, 4, and 5 because of changes in inventory.

[7] Differs from totals shown in tables 1, 2, and 3 because of changes in inventory.

Table 8.—Distribution (shipments) of evaporated and rock salt in the United States, by destination

(Thousand short tons)

Destination	1973		1974			
	Evaporated	Rock	Evaporated		Rock	
			Domestic	Imported	Domestic	Imported
Alabama	55	320	54	(1)	381	--
Alaska	W	W	W	--	--	--
Arizona	33	4	35	16	3	--
Arkansas	21	90	25	--	69	--
California	986	W	1,036	127	W	--
Colorado	90	W	117	--	32	--
Connecticut	17	W	16	19	W	2
Delaware	6	W	7	30	W	2
District of Columbia	3	W	2	2	W	1
Florida	51	137	54	--	153	--
Georgia	62	260	62	--	W	(1)
Hawaii	W	--	W	--	--	--
Idaho	70	W	68	--	3	--
Illinois	365	1,046	355	3	1,073	14
Indiana	165	459	163	(1)	559	37
Iowa	196	329	189	(1)	341	3
Kansas	94	179	101	--	218	--
Kentucky	49	505	49	--	552	(1)
Louisiana	52	628	48	(1)	564	--
Maine	10	W	10	(1)	W	1
Maryland	42	81	67	164	58	7
Massachusetts	42	320	43	63	444	W
Michigan	206	W	212	(1)	W	630
Minnesota	136	290	151	5	322	50
Mississippi	22	103	22	--	111	--
Missouri	113	314	107	--	398	--
Montana	74	1	66	--	1	--
Nebraska	127	95	119	--	85	--
Nevada	37	W	37	9	W	--
New Hampshire	W	77	5	(1)	135	W
New Jersey	160	W	140	86	657	17
New Mexico	61	47	W	--	35	--
New York	322	1,192	320	40	1,723	83
North Carolina	122	155	111	20	144	(1)
North Dakota	W	5	72	--	6	1
Ohio	401	1,035	356	(1)	1,383	122
Oklahoma	54	66	47	--	65	--
Oregon	60	W	56	218	W	--
Pennsylvania	190	565	186	70	1,012	45
Rhode Island	15	W	17	1	W	--
South Carolina	45	19	47	--	16	--
South Dakota	60	32	63	--	34	--
Tennessee	124	539	124	(1)	621	(1)
Texas	198	255	193	--	245	--
Utah	231	W	252	--	W	--
Vermont	7	W	6	(1)	183	--
Virginia	98	W	102	23	133	(1)
Washington	116	(1)	90	655	(1)	--
West Virginia	23	140	24	1	130	1
Wisconsin	191	483	196	1	531	248
Wyoming	25	3	29	--	W	--
Other [2]	279	2,301	241	2	2,183	115
Total [3]	[4] 5,905	[4] 12,024	[4] 5,893	[5] 1,558	[4] 14,599	[5] 1,377

W Withheld to avoid disclosing company confidential data; included with "Other."

[1] Less than ½ unit.

[2] Includes shipments to overseas areas administered by the United States, Puerto Rico, exports, some shipments to unspecified destinations, and States indicated by symbol W.

[3] Data may not add to totals shown because of independent rounding.

[4] Differs from totals in tables 2, 4, and 5 because of changes in inventory.

[5] Differs from totals in tables 1, 11, 12, and 13 because of incomplete data on the distribution of imported salt.

PRICES

Salt prices quoted at yearend 1974 by Chemical Marketing Reporter, unchanged from 1973, follow:[4]

	Per 100 pounds
Salt, evaporated, common, 100-pound bags, carlots or truck-lots, works	$1.48
Salt, chemical-grade, same basis	1.54
Salt, rock, medium coarse, same basis	.97
Salt, rock, extra coarse, same basis	1.02

The average value of different classes of salt in bulk, f.o.b. works, as reported by salt producers in the Bureau of Mines annual survey follow:

	Per ton	
	1973	1974
Evaporated:		
Open pans or grainers	$31.52	$34.18
Vacuum pans	29.32	34.56
Solar	8.99	9.30
Pressed blocks, all sources	32.62	36.77
Rock salt, bulk	6.19	7.14
Salt in brine	3.57	3.69

Fuel costs escalated sharply in 1974 and were passed on in the value of the finished products, especially in vacuum-pan evaporated salt.

The weighted average price increase for all salt was 11%; the greatest increase was in vacuum-pan salt with a gain of 18%; and the lowest increase occurred in solar salt and brine at 3.4%.

FOREIGN TRADE

In 1974 the United States imported 6.8% of its apparent consumption and exported 1.1% of its production. Importation of salt from the Bahamas was primarily an accommodation to the economy of these islands. Shipments of about 1 million tons of salt up the Pacific coast from Mexico to California, Oregon, and Washington were used primarily in the pulp and paper industry of the Northwest.

The salt trade across the Canadian-United States border occurred in both directions where shipping distances could be kept shorter than that required for domestic salt. The United States imported 1,238,000 tons from Canada, but exported 464,000 tons, a net importation of 774,000 tons. The nominal tariff imposed on imported salt apparently had little effect on the movement of salt into the United States.

Tables 11, 12, 13, which report salt imports to the United States, were prepared from data supplied by the U.S. Department of Commerce. Table 14, however, was based on the Bureau of Mines salt survey and apparently covers only 87% of the total imports.

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[4] Chemical Marketing Reporter. V. 206, No. 27, Dec. 30, 1974, p. 31.

Table 9.—Salt shipped to the Commonwealth of Puerto Rico and overseas areas administered by the United States

Area	1973		1974	
	Quantity (short tons)	Value (thousands)	Quantity (short tons)	Value (thousands)
American Samoa	505	$24	275	$16
Puerto Rico	r 18,674	r 1,776	18,694	1,758
Virgin Islands	r 360	r 20	98	19

r Revised.

Table 10.—U.S. exports of salt, by country
(Thousand short tons and thousand dollars)

Destination	1973		1974	
	Quantity	Value	Quantity	Value
Australia	(1)	4	1	20
Bahamas	3	118	2	66
Belgium-Luxembourg	(1)	1	1	49
Canada	561	3,383	464	2,850
Costa Rica	(1)	29	(1)	36
Honduras	(1)	19	(1)	18
Jamaica	1	14	(1)	13
Japan	26	102	2	22
Mexico	5	87	23	160
Netherlands Antilles	1	69	1	85
New Zealand	1	31	(1)	20
Panama	1	63	1	45
Peru	--	--	1	107
Philippines	1	7	(1)	2
Saudi Arabia	2	167	3	387
South Africa, Republic of	1	20	(1)	2
Trinidad and Tobago	(1)	15	(1)	9
United Arab Emirates	2	44	(1)	28
United Kingdom	(1)	51	5	65
Other	4	176	17	292
Total	609	4,400	521	4,276

[1] Less than ½ unit.

Table 11.—U.S. imports for consumption of salt, by country
(Thousand short tons and thousand dollars)

Country	1973		1974	
	Quantity	Value	Quantity	Value
Bahamas	r 889	r 3,833	931	3,934
Canada	1,079	5,421	1,238	6,580
Chile	143	645	79	370
Germany, West	--	--	[1] 9	[1] 77
Mexico	973	2,166	1,018	2,939
Netherlands	--	--	10	44
Netherlands Antilles	123	440	73	451
Other	(2)	49	(2)	33
Total	r 3,207	r 12,554	3,358	14,428

r Revised.

[1] Includes salt brine from West Germany through Baltimore customs district, 8,800 short tons ($4,926).

[2] Less than ½ unit.

Table 12.—U.S. imports for consumption of salt, by class
(Thousand short tons and thousand dollars)

Year	In bags, sacks, barrels or other packages (dutiable)		Bulk (dutiable)	
	Quantity	Value	Quantity	Value
1972	26	535	3,437	11,444
1973	27	559	r 3,180	r 11,995
1974	28	746	[1] 3,330	[1] 13,681

r Revised.

[1] Includes salt brine from from West Germany through Baltimore customs district 8,800 short tons ($4,926).

Table 13.—U.S. imports for consumption of salt, by customs district

(Thousand short tons and thousand dollars)

Customs district	1973		1974	
	Quantity	Value	Quantity	Value
Baltimore, Md	176	746	106	591
Boston, Mass	[r] 88	[r] 250	48	248
Buffalo, N.Y	19	95	40	207
Chicago, Ill	33	169	107	496
Cleveland, Ohio	122	595	96	460
Detroit, Mich	588	2,950	671	3,491
Duluth, Minn	59	329	62	431
Los Angeles, Calif	162	409	150	564
Milwaukee, Wis	234	1,151	247	1,281
Mobile, Ala	17	70	--	--
New Orleans, La	--	--	11	40
New York City	201	[r] 755	202	946
Norfolk, Va	35	147	29	130
Ogdensburg, N.Y	10	31	10	76
Philadelphia, Pa	(1)	3	(1)	3
Portland, Maine	194	1,140	151	682
Portland, Oreg	302	685	384	1,181
Providence, R.I	25	76	--	--
St. Albans, Vt	(1)	4	2	55
San Juan, P.R	135	541	240	971
Savannah, Ga	251	932	277	1,129
Seattle, Wash	497	1,002	505	1,278
Wilmington, N.C	59	442	20	90
Other	(1)	32	(1)	78
Total	[r] 3,207	[r] 12,554	3,358	14,428

[r] Revised.
[1] Less than ½ unit.

Table 14.—U.S. imports for consumption of salt, by use as reported by salt producers

(Thousand short tons)

Use	1973	1974
Government (highway use)	1,227	1,354
Chemical industry	970	957
Water conditioning service companies	129	194
Other	422	424
Total	2,748	[1] 2,930

[1] Data does not add to total shown because of independent rounding. Disagreement with totals in tables 1, 11, 12, and 13 is because of incomplete data on the uses of imported salt.

WORLD REVIEW

World salt production in 1974 was estimated at 172 million tons. Distribution of the salt production in 1974 by continent follows:

	Million tons	Percent
Europe	67.2	39
North America	59.0	34
Asia	33.4	20
Oceania	5.4	3
South America	5.3	3
Africa	2.1	1

The 12 top-ranking salt-producing nations, which accounted for 81% of the world's salt, are listed below in order of percent of world salt output:

	Percent
United States	27
People's Republic of China	11
U.S.S.R	8
Germany, West	7
United Kingdom	5
India	4
France	4
Italy	3
Canada	3
Australia	3
Mexico	3
Poland	2

Australia.—Solar salt production in Western Australia became a major industry with production of about 5.3 million tons per year, and this rate was expected to double within a few years. Capital expenditures for salt production were estimated at $79 million. The companies operating in Australia were Shark Bay Gypsum Co., Dampier Salt, Ltd., Leslie Salt, Pty., Ltd., Texada Mines, Ltd., and Lefroy Salt, Pty., Ltd. Most of the salt produced was exported to Japan.[5]

Canada.—Domtar Chemicals Ltd. was expanding its salt facilities at Unity, Saskatchewan, by 38% to 200,000 tons per year. Expenditure for this addition was estimated at $1.5 million.[6]

China, People's Republic of.—The People's Republic of China (PRC) continued to be the world's second-ranking producer of salt. Mechanization and bulk handling techniques were responsible for gains of as much as 25% in 1974 output. Most of the PRC's salt came from solar evaporation of seawater, and many valuable byproducts besides salt were extracted from this raw material. Some of the salt fields were inland, such as the Chilantei field in Ningsia Hui Autonomous Region, but most of them lay along the coast. The largest of these was the Tangku salt field on Pohai Bay near the city of Tientsin. Rock salt was mined in Yunnan, Kiangsi, and Hunan Provinces.

Denmark.—A major salt producer in Denmark was Dansk Salt I/S, located near the town of Hvornum in eastern Jutland. The salt supply was a salt dome about 1.9 miles in diameter and 2.5 miles in depth located about 2,000 feet below the surface. Solution mining was employed to remove the salt, and the brine was evaporated in vacuum pans. Production capacity was estimated at 386,000 short tons per year.

Salt production in Denmark in 1973 was reported to be 406,000 short tons; 184,000 short tons were exported, primarily to Sweden and Norway. These exports were offset by the importation of 189,000 tons of salt primarily from West Germany, Italy, the U.S.S.R., and Poland.[7]

Mexico.—The world's largest solar salt producer, Exportadora de Sal of Guerrero Negro, Baja California, has previously supplied Japan under contract 2.8 million tons of salt per year at $3.56 per ton. In June 1974, the contract was increased to ship 3.3 to 3.7 million tons of salt per year at a 40% increase in price to $4.98 per ton. A project is under construction which will increase production capacity by 38% to 6.5 million tons per year.

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[5] Skillings' Mining Review. Solar Salt Now Major Australian Industry. V. 63, No. 44, Nov. 2, 1974, p. 6.

[6] Engineering and Mining Journal. V. 176, No. 1, January 1975, p. 88.

[7] Industrial Minerals. The Industrial Minerals of Denmark. No. 89, February 1975, pp. 9–11, 29.

Table 15.—Salt: World production, by country

(Thousand short tons)

Country[1]	1972	1973	1974 p
North America:			
Bahamas	890	1,286	1,182
Canada	5,417	5,565	5,704
Costa Rica	r 22	14	15
Dominican Republic e	43	43	43
El Salvador	32	39	29
Honduras e	30	r 35	35
Martinique e	330	330	330
Mexico	5,025	4,761	e 4,740
Netherlands Antilles e	220	530	530
Nicaragua	e 17	e 11	11
Panama	12	23	e 28
United States (including Puerto Rico):			
Rock salt	14,434	12,347	14,835
Other salt:			
United States	30,587	31,564	31,559
Puerto Rico	29	29	29
South America:			
Argentina	r 905	771	e 780
Brazil	r 2,390	2,044	e 2,090
Chile	482	380	e 390
Colombia:			
Rock salt	384	518	e 550
Other salt	743	929	e 990
Peru	238	r e 240	e 240
Venezuela	236	303	246
Europe:			
Austria:			
Rock salt	1	1	(2)
Other salt	548	593	586

See footnotes at end of table.

Table 15.—Salt: World production, by country—Continued

(Thousand short tons)

Country [1]	1972	1973	1974 [p]
Europe—Continued:			
Bulgaria	115	121	[e] 130
Czechoslovakia	[r] 247	[e] 240	[e] 240
Denmark	337	406	[e] 495
France:			
Rock salt and brine salt	4,664	5,273	5,419
Marine salt	1,109	[e] 1,100	1,190
Germany:			
East	2,411	2,520	[e] 2,650
West (marketable):			
Rock salt	6,644	7,236	7,919
Marine salt and other	[r] 2,683	4,009	[e] 4,200
Greece	163	[r] [e] 170	[e] 170
Italy:			
Rock salt and brine salt	[r] 3,704	4,086	4,416
Marine salt	793	1,284	[e] 1,320
Malta	(2)	(2)	[e] (2)
Netherlands	3,090	3,355	3,734
Poland:			
Rock salt	1,333	1,389	1,549
Other salt	1,985	2,005	2,083
Portugal:			
Rock salt	315	333	341
Marine salt	234	[e] 230	[e] 230
Romania	3,469	3,633	4,324
Spain:			
Rock salt	[r] 1,340	1,433	[e] 1,540
Marine salt and other evaporated [3]	[r] 717	796	[e] 880
Switzerland	282	319	330
U.S.S.R.	[r] 13,448	[r] [e] 13,450	[e] 13,780
United Kingdom:			
Rock salt	1,430	1,077	1,102
Other salt	[r] [e] 8,380	8,154	[e] 8,160
Yugoslavia	296	365	360
Africa:			
Algeria	119	143	154
Angola	138	107	[e] 110
Dahomey	--	--	3
Egypt, Arab Republic of	422	501	[e] 550
Ethiopia: [4]			
Rock salt	11	[e] 11	[e] 11
Marine salt	309	118	134
Ghana	[e] 55	48	[e] 50
Kenya	[r] 41	39	[e] 40
Libya	[r] [e] 11	[r] [e] 11	11
Malagasy Republic	23	[e] 22	[e] 22
Mali [e]	3	3	3
Mauritania [e]	1	1	1
Mauritius	6	[e] 7	6
Morocco	50	30	40
Mozambique	34	46	[e] 23
Niger	[e] 2	[e] 2	2
Senegal	149	134	165
Somali Republic [e]	2	2	2
South Africa, Republic of	408	431	243
South-West Africa, Territory of: Marine salt [e]	121	121	121
Sudan	66	33	55
Tanzania	36	42	38
Togo	NA	NA	(2)
Tunisia	364	391	269
Uganda [e]	3	3	3
Asia:			
Afghanistan [4]	34	42	56
Bangladesh	[e] 350	[e] 330	187
Burma	174	188	246
China, People's Republic of [e]	19,800	[r] 19,800	19,800
Cyprus	6	7	4
India	[r] 7,185	7,563	[e] 6,990
Indonesia	198	[e] 220	[e] 220
Iran [4]	[r] 441	386	441
Iraq [e]	60	70	70
Israel	68	68	124
Japan	757	1,119	1,229
Jordan	26	28	28
Khmer Republic	40	[e] 44	[e] 44
Korea, North [e]	600	600	600
Korea, Republic of	498	817	638
Kuwait	5	11	[e] 11
Laos	9	10	11
Lebanon	[r] [e] 39	[r] [e] 39	39
Mongolia	11	[e] 12	[e] 12

See footnotes at end of table.

Table 15.—Salt: World production, by country—Continued

(Thousand short tons)

Country[1]	1972	1973	1974[p]
Asia—Continued:			
Pakistan:			
Rock salt	399	417	421
Other salt	[r] 247	112	[e] 150
Philippines	242	243	[e] 248
Ryukyu Islands[e]	6	6	6
Sri Lanka	174	136	[e] 150
Syrian Arab Republic	55	[r] [e] 55	[e] 55
Taiwan	485	419	400
Thailand[e]	180	180	180
Turkey	474	[r] [e] 550	[e] 550
Vietnam:			
North[e]	165	165	165
South	[r] 212	220	[e] 220
Yemen, Arab Republic of	[r] 1	--	--
Yemen, People's Democratic Republic of	83	[r] [e] 83	[e] 83
Oceania:			
Australia	[5] 3,682	[5] 4,473	[e] 5,290
New Zealand	[r] 66	112	60
Total	[r] 161,350	166,611	172,228

[e] Estimate. [p] Preliminary. [r] Revised. NA Not available.

[1] Salt is produced in many other countries, but quantities are relatively insignificant or reliable data are not available.

[2] Less than ½ unit.

[3] Includes an average annual production in the Canary Islands of about 13,000 short tons of marine salt.

[4] Year beginning March 21 of that stated.

[5] Excludes Victoria.

TECHNOLOGY

A survey of the energy requirements for various types of salt production was conducted in 1974. Average energy usages for the different classes of salt follow:

	Kilowatt-hours per ton	Thousand Btu per ton
Salt in brine	6.0	20.5
Solar-evaporated salt	23.5	80.1
Mined rock salt	29.5	101
Vacuum-pan salt	1,230	4,190

U.S. dependence on foreign oil has frequently led to the suggestion that about a year's supply of petroleum be stored for future use in underground cavities created by solution mining of salt. The storage volume required would be about 3.2 billion barrels, or 18 billion cubic feet. The volume created by all the solution mining of salt in 1974 would accommodate less than 8 days of U.S. petroleum consumption. About 47 years of solution mining at this rate would be required to create sufficient storage volume for 1 year's petroleum supply. This figure is a minimum and would apply only if there were no cavern failures and if all of the underground volume were made available for petroleum storage. Neither condition is a practical probability. There are no known salt cavities which are not now being utilized for other purposes.

At Huntorf, West Germany, an abandoned salt cavity is to be used to store compressed air which will be pumped into the cavity during off-hours and withdrawn to generate electricity during peak demands. The cavern has a volume of about 10 million cubic feet and is 2,000 to 2,600 feet below the surface. Air pressure up to 1,000 pounds per square inch will be used. The powerplant is designed to deliver 290 megawatts of power.[8]

Preliminary steps toward building a 100-million-gallon-per-day desalination plant to be fed by Colorado River waters were taken by the Office of Saline Water, near Yuma, Ariz.[9]

A novel use for salt was under development by the firm of Pope, Evans, and Robbins in Alexandria, Va. About 1 part of salt and 10 parts of limestone were injected into the combustion chamber of a small boiler to minimize sulfur contamination in the stack gases. Limestone was the active reagent to convert the gaseous sulfur compounds to filterable solids, and the salt apparently acted only as a catalyst in the reaction. The presence of salt, however, improved the effectiveness of sulfur removal. The results of this experimental work will be applied to a full-size, 30-megawatt powerplant in Rivesville, W. Va., which is scheduled for startup about April 1976. If successful, this process could develop a sizable new market for rock salt.

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[8] Chemical Engineering. More Construction and Expansion in the News. V. 81, No. 14, July 8, 1974, p. 29–30.

[9] Chemical and Engineering News. Desalting Tests Have Begun. V. 52, No. 30, July 29, 1974, p. 12.

Sand and Gravel

By Walter Pajalich [1]

In 1974, sand and gravel production, including industrial sand and gravel, decreased about 1% to 979 million tons, valued at $1.5 billion. The value increased about 7% over that of 1973.

About 97% of the sand and gravel produced was used as construction aggregate and about 3% was used as industrial sand and gravel. Of the total construction aggregate, about 96% was produced by commercial operations and 4% by government-operated pits with their own crews and equipment for use on publicly funded projects. Of the total construction aggregate, about 75% was used commercially and about 25% was used for publicly funded projects.

Alaska, with reported sales of 118 million tons of sand and gravel, became the leading State in the Nation. Most of this was unprocessed sand and gravel sold by the Bureau of Land Management from Federal lands for use in the construction of the oil pipeline. Accurate consumption figures on the pipeline will be available in 1975. When the increase of 102 million tons, above the usual sand and gravel production in Alaska, are excluded from the National statistics, sand and gravel production decreased about 11%.

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[1] Mining engineer, Division of Nonmetallic Minerals.

Table 1.—Salient sand and gravel statistics in the United States [1]
(Thousand short tons and thousand dollars)

	1970	1971	1972	1973 [2]	1974 [2]
Production:					
Processed:					
Sand:					
Quantity	320,764	327,947	330,384	346,996	322,607
Value [3]	362,308	398,469	418,050	472,292	494,509
Gravel:					
Quantity	517,358	483,748	461,925	510,031	404,411
Value [3]	604,414	608,847	607,263	706,329	697,975
Unprocessed:					
Sand and gravel:					
Quantity	76,676	81,740	92,485	97,627	222,666
Value	47,791	50,286	63,002	70,684	119,888
Industrial:					
Sand:					
Quantity	29,145	26,161	29,530	28,974	28,024
Value	101,191	91,371	112,386	110,065	135,357
Gravel:					
Quantity	--	--	--	--	1,046
Value	--	--	--	--	3,342
Total: [4]					
Quantity	943,941	919,593	914,324	983,629	978,754
Value	1,115,705	1,148,969	1,200,701	1,359,370	1,451,071
Imports:					
Quantity	879	715	761	800	394
Value	1,600	1,227	1,379	1,576	839
Exports:					
Quantity	1,210	1,728	1,821	1,744	2,256
Value	5,944	6,745	7,178	8,597	11,664

[1] Puerto Rico excluded from all sand and gravel statistics.

[2] Data not directly comparable with those of previous years because of changes in industry coverage (1973, 1974) and canvass form (1974).

[3] Unit value of sand or gravel may be lower than construction aggregate (1974) shown in tables 2 and 3.

[4] Data may not add to totals shown because of independent rounding.

New Data Collection System.—The 1974 sand and gravel canvass form was modified. Every location where sand and gravel is mined, on land or water, was classed as an "operation" and a canvass form recording production and other data was requested annually. A company with numerous operations prepared a canvass form for each operation. In most cases a processing plant was part of the operation. At some operations there was no processing plant and the material was sold or used as mined.

In former years the number of sand and gravel mines in the United States was based on a processing plant count. Because some operations have more than one processing plant at one location and others have none, the mine count is now based on "operations" as defined above.

Production of sand and gravel and its use as a construction aggregate in 10 different use categories was collected. As "Concrete Aggregate" the use pattern has been divided into "Nonresidential and residential construction," "Highway and bridge construction," "Concrete products, such as blocks, pipe, bricks, etc.," and "Other uses such as dams, waterworks, airports, etc." Other processed aggregate uses were "Bituminous paving" and "Roadbase and subbase," "Fill," and "Other." As unprocessed aggregate the use pattern has been divided into "Fill" and "Roadbase and subbase."

All of the above uses of construction aggregate were classified into two divisions, aggregate material used for "commercial projects" and "publicly funded projects." Aggregate used for construction projects financed by county, State, or Federal government funds was classified as used on "publicly funded projects." Some counties, States, and Federal agencies own and operate, with their own crews and equipment, sand and gravel operations. These noncommercial operations were also canvassed, data on them were collected and included in the "publicly funded projects" classification. About 4% of the Nation's sand and gravel came from these operations.

Production data were collected as sand and gravel and the use pattern data were collected as construction aggregate. Unit value per ton of sand or gravel, in most were made comparable with the 1974 format wherever possible.

For statistical continuity, the 1973 data were made comparable with 1974 format wherever possible.

Data in tables 11 to 15 will be collected on a 3-year rotational supplemental form. The same data will appear again in 1977 and in 1980. Other basic data about the industry will be collected in 1975 and 1976, and repeated in subsequent 3-year periods.

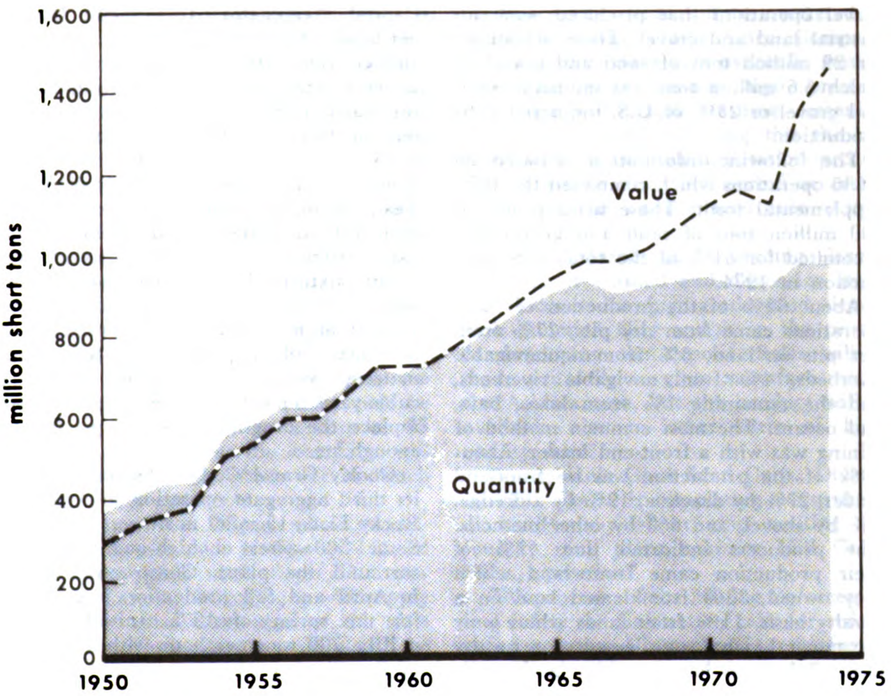

Figure 1.—Production and value of sand and gravel in the United States.

DOMESTIC PRODUCTION

Alaska, with reported sale of 118 million tons of sand and gravel ranked first in the Nation. California was second with a production of 105 million tons. Michigan ranked third. Other States producing substantial quantities of sand and gravel, in descending order of production, were Illinois, Texas, Ohio, Minnesota, and New York. Combined, the eight leading States accounted for 477 million tons, about 49% of the total U.S. output. The value of sand and gravel in these eight States was $619 million, 43% of the Nation's total.

The number of construction and industrial sand and gravel operations increased from 5,681 in 1973 to 6,967 in 1974. This was due in part to increased coverage of the industry. These operations were owned by 4,844 companies.

Of the 6,967 sand and gravel operations, 5,718 had processing plants associated with their land or dredging operations, 1,249 had no processing plant and the material was sold as mined. Some of the 5,718 operations have more than one plant on location for processing mined material from a single pit.

There were 5,637 construction sand and gravel operations with a production under 200,000 tons per year. These operations accounted for 33% of the total U.S. production. There were 780 operations with production between 200,000 and 500,000 tons, and they accounted for 26% of the production. The remaining 331 operations, with production over 500,000 tons, accounted for 41% of production.

There were 118 operations in the United States that produced only industrial sand and gravel and accounted for 22 million tons or 77% of the U.S. industrial sand production. All of these had a processing plant associated with the operation. Of these there were 107 operations with a production under 500,000 tons per year.

There were 101 construction sand and gravel operations that produced some industrial sand and gravel. These accounted for 29 million tons of sand and gravel of which 6.6 million tons was industrial sand and gravel or 23% of U.S. industrial sand production.

The following information is based on 5,636 operations which completed the 1974 supplemental form. These firms produced 790 million tons of sand and gravel and accounted for 81% of the total U.S. production in 1974.

About 62% of the production of these operations came from dry pits, 27% from wet pits on land, 6% from nonnavigable riverbeds, 4% from navigable riverbeds, and the remaining 1% from lakes, bays, and oceans. The most common method of mining was with a front-end loader. About 39% of the production was by front-end loader, 27% by dragline, 19% by a dredge, 9% by shovel, and 6% by other methods. The producers indicated that 47% of their production came from land which they owned, 33% from leased land on a royalty basis, 11% from lands where only the mineral rights were leased on a royalty basis, 7% from leased public lands on a royalty basis, and 2% was mined from lands where they own only the mineral rights.

The total estimated capital investment at these operations was about $2 billion. Capital investment was based on the estimated 1974 yearend market value of all physical fixed assets including mining equipment, processing plant, buildings at mine site, and all trucks, barges, or other transportation equipment associated with production. Excluded are cost of land, mineral rights, and inventories. The estimated sand and gravel reserves at 3,145 operations which responded to this question was 8.4 billion tons.

Factors that have added to the consumer cost of sand and gravel included increased labor costs, growing land values, cost of land rehabilitation, cost of fuel, and longer haulage distances.

The industry continued to make progress in the use of larger operating units, more efficient portable and semiportable plants, versatility of plant capacity, and greater awareness of pollution control and land rehabilitation.

Mechanization of material handling has virtually eliminated the need for haul trucks and front-end loaders within the Capital Aggregates, Inc., new 715-ton-per-hour sand and gravel plant. Field and conventional belt conveyors, traveling stackers, and gravity withdrawal, handle the material from the pit, through processing and to loadout hoppers. Capital Aggregates, is a subsidiary of H.B. Zachry, Inc. The new plant, located southeast of Austin, Tex., occupies some 459 acres of land divided by the Colorado River. The deposit varies from 65% sand, 35% gravel, to a 50-50 mixture. The average depth of the deposit is 36 feet. It is covered by about 10 feet of fine sand which is used in the hot mix asphalt plant or is sold as fill material. Mining is being done by a 3-½-cubic-yard bucket dragline. A dredge will replace the dragline once the pit is large enough.[2]

Cooley Gravel Co. of Denver will open its third aggregate operation in 3 years at Rocky Flats, 15 miles northwest of Denver. Some 500 acres of high-quality reserves surround the plant. Construction started in April and full production is scheduled for the spring of 1975. Initial capacity will be 700 tons per hour with a potential of 1 million tons per year.[3]

West Coast Silica, of Overton, Nev., has been purchased by Johns-Manville Corp. and will operate as part of the latter's mining division. The silica sand is used in asbestos cement pipe, for irrigation, and water and sewage transmission.[4]

Spezio Construction Co. purchased the Pittsford Gravel Corp. at Mendon, south of Rochester, N.Y., in 1961, and mined the deposit profitably until 1968. The company than decided to make the mined out pit a landfill for demolition and excavation debris to build the 580 acres up to ground level for a 3,000-unit housing development. Careful engineering, planning and execution, and a great deal of public relations work were needed to overcome obstacles to the project. With the landfill now almost completed, work will start on the housing development with many benefits for the town of Mendon.[5]

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[2] Robertson, Joseph L. Belt Conveyors Deliver Material from Pit to Loadout. Rock Products, v. 77, No. 2, February 1974, pp. 38–41.

[3] Rock Products. Rock Newscope. V. 77, No. 2, February 1974, p. 17.

[4] Rock Products. Rock Newscope. V. 77. No. 3, March 1974, p. 17.

[5] Pit & Quarry. Public Antagonism Converted to Staunch Program Converting Waste Site to Valuable Property. V. 66, No. 8, February 1974, pp. 84–85, 89.

Yuba Goldfields, Inc., of California has formed the Yuba Aggregate Division as the firm's marketing branch for sand and gravel throughout the State. The company is planning to develop a major cement and concrete manufacturing-oriented industrial complex at Yuba's 10,000 acre site at Hammonton.[6]

HC&D, Ltd., announced plans to begin producing artificial sand within 18 months in Hawaii. "Man-sand," short for manmade sand or manufactured sand, will be made from pulverized lava rock dug from the firm's Kapaa quarry on Windward Oahu. The new sand is reported to be stronger than coral beach sand and is competitive in price. Under present projections, the plant situated next to the quarry, will be completed in mid-1975 at a cost of $5 million. At that time, the company will be able to completely phase out its beach sand dredging operation.

Construction has begun on a several-hundred-acre site near Hoffman, N.C., of a new silica glass sand plant. The new company, Carolina Silica, Inc., will supply high-quality silica glass sand to the glass industry in North Carolina. This will be the only plant of its kind in the State. The plant, located approximately 12 miles south of Southern Pines on U.S. Highway No. 1, will also produce filtration and blasting sand, which will be marketed by Southern Products and Silica Company. Mining will be done by a hydraulic method employing water under high pressure. Processing will include washing, screening, and classification. Following this the material will go through a flotation process, then it will be dried and sorted according to particle size and placed into storage silos.[7]

Georgia Marble Co., a leading Georgia producer of crushed and dimension stone, has discovered a high-grade sand deposit near Junction City and is in the process of developing the deposit. Sales will be made primarily to glass manufacturers in the Atlanta area, but the product will be available also to other users of high-quality sand.

Pennsylvania Glass Sand Corp., Division of ITT, Corp., is completing construction of a 134-ton-per-hour glass melting and foundry sand plant near its Mill Creek, Okla., operation.[8]

The program of the Mining Enforcement and Safety Administration calls for stricter enforcement and inspections in the future. By 1975, they expect to inspect every aggregate operation in the country.

CONSUMPTION AND USES

In 1974, U.S. consumption of sand and gravel amounted to 979 million tons valued at $1.5 billion. The construction industry, the prime user of sand and gravel, consumed 97% of the tonnage, representing 90% of the value of the sand and gravel output in 1974. Of the sand and gravel consumed by the construction industry as concrete aggregate, 24% went into nonresidential and residential construction, 8% into highways and bridge construction, 7% into concrete products, and 2% into other. Bituminous paving consumed 15%, roadbase and subbase 16%, fill 3%, and other consumption 2%. As unprocessed sand and gravel, 11% was used as fill and 12% as roadbase and subbase.

Industrial uses were expanded to include gravel which was used for metallurgical purposes.

PRICES

Representative carlot prices of sand in 14 cities at the end of 1973 ranged from $1.35 per ton in Detroit to $5.50 per ton in Chicago, according to the Engineering News-Record.[9] The average of the sand prices reported was $3.05 per ton compared with $3.55 per ton in 1973. Prices for either ¾- or 1½-inch gravel ranged from $0.75 per ton in Birmingham to $5.45 per ton in Los Angeles. The average of the ¾-inch gravel prices reported for 14 cities was $3.55 per ton compared with $3.66 per ton in 1973. For 1½-inch gravel, the average for 14 cities was $3.52 per ton compared with $3.92 per ton in 1973.

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[6] Pit & Quarry. Industry News. V. 67, No. 6, December 1974, p. 19.

[7] Pit & Quarry. Carolina Silica Building Glass Sand Operation. V. 67, No. 2, August 1974, p. 19.

[8] The Glass Industry. Newsletter. V. 55, No. 7, July 1974, p. 6.

[9] Engineering News-Record. V. 193, No. 24, Dec. 5, 1974, pp. 28–29.

Based on the Bureau of Mines canvass, the average value of processed sand and gravel sold or used by producers, f.o.b. plant, was $1.64 per ton; unprocessed sand and gravel was $0.54; industrial sand and gravel was $4.77 per ton. Overall average value of sand and gravel was $1.48; the comparable value in 1973 was $1.38.

FOREIGN TRADE

The U.S. exports gravel, construction sand and gravel, and industrial sand. In 1974, gravel exports totaled 472,896 tons, valued at $667,942, construction sand and gravel totaled 658,801 tons, valued at $1,131,845, industrial sand totaled 1,123,954 tons, valued at $9,864,134. Canada received 98% of the gravel and Mexico 1%, and the remainder was shipped to 20 different countries. Canada received 88% of the construction sand and gravel and the Bahamas 11%; the remainder was shipped to 26 different countries. Canada received 68% of the industrial sand and Mexico 28%, and the remainder was shipped to 58 other countries.

Most of the crude sand and gravel imported in 1974 was from Canada. Almost all of the imported glass sand was from Australia.

WORLD REVIEW

France.—In 1973 France produced 207 million tons of gravel. The projected production rate of the industry is expected to grow at 9.3% per year for the next 5 to 6 years. Most of the sand and gravel industry is dispersed, with a few major companies and many family businesses. The major sources of sand and gravel are the Seine, Rhône, Loire, and Rhine Valleys. Imported sand and gravel comes from the United Kingdom. British sea-dredging companies land marine gravel at channel ports, particularly at Dunkirk.

The Groupe Garon, in Lyons, is the second largest sand and gravel producer in France with an annual output of 12 million tons. The firm has operations on land and also dredges in the Rhône and Saone Rivers. Another large company, Compania des Sablières de la Seine at Bernières, some 13 miles southeast of Rouen, is mining a deposit alongside the river. Using dry-mining methods for the material above the water table and a dragline below the water table, the company produces about 7,500 tons per day. About 80% of the sand and gravel from this deposit is barged into Paris and the remaining amount is trucked there.[10]

Germany, West.—To meet the shortage of natural sand in West Germany's upper Bavarian region, a crushing plant was designed and erected by Freid R. Krupp. GmbH, near Rosenheim on the bank of the Inn River. The crushing plant reduced 32 to 100 millimeter rounded gravel to 0 to 4 millimeter concrete sand. The capacity of the plant is 50 tons per hour.[11]

Panama.—The new 200-ton-per-hour plant of Cantera Le Esmeralda near Ojo de Agua, is capable of simultaneously producing three different rock products plus sand. It can load and/or stockpile three different products at the same time. The operation can sell seven different products, either washed or dried. Most of the processing is controlled by a single operator at a station above the jaw crusher.[12]

Sweden.—A new Swedish law requires all machinery used for aggregate production to be totally enclosed, preferably in rubber. The law, while primarily designed to prevent dust, is also intended to cut down noise, and applies regardless of the plant location. The first aggregate plant to be built since the law was adopted was Armerad Betong at Sodra Sandby in south Sweden by A. B. Mataki, one of the largest road contractors in Sweden. The plant is located in a forest area away from any populated community. Dust sealing is achieved with rubber cloth and fabric. The dust exhaust from the crushing and screening units is trapped in dust collectors. Effectiveness of the airtight seals made it possible to reduce the size of fans and filters, in comparison to the use of conventional open hoods. The noise level was cut by the dampening effect of the rubber by 15 to 20 decibels.[13]

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[10] Fish, Brian G. Quarrying in France. Quarry Management and Products, v. 1, No. 4, September 1974, pp. 125–134.

[11] Ballon, H. Cone Crushers Reduce Gravel to Concrete Sand. Rock Products, v. 77, No. 11, November 1974, pp. 48–49.

[12] Pit and Quarry. New 200-ton-per-hour Panama Aggregates Plant Displays Efficiency, Flexibility. V. 67, No. 3, September 1974, pp. 110–111.

United Kingdom.—During the past 10 years the trend in the United Kingdom has been toward establishing fewer but larger sand and gravel companies. One of the major reasons behind this trend seems to be the increasing installation and upkeep costs of a new plant. A larger part of this stems from stricter environmental control regulations. It is not uncommon for efficient dust control and ancillary environmental protection equipment to cost at least as much as the processing plant. Also, the cost of the new plant often increases with size. Although the internal structure of the companies involved in sand and gravel industry has changed, the processing equipment used and services offered are still the same.

The Stevens and Verney Committees, appointed by the Government in 1972, continued their investigation of problems relating to the aggregate industry. The Stevens Committee is reviewing legislation concerned with the planning control of mineral extraction and the Verney Committee is looking into questions relating to the supply of aggregates. A preliminary report has been issued by the Verney Committee.

Committees of the British Standards Institutions have changed and revised standards for rolled asphalt which eliminated many arbitrary restrictions. These restrictions formerly excluded many gravels from use in roads. New standards for concrete aggregates and building sand have been published. These standards will permit and require the testing of aggregates in metric terms. This will complete the changeover to the metric system for the sand and gravel industry.

The British Sand and Gravel Association, Ltd., research team is classifying aggregates. They are primarily concerned with the mechanical properties of aggregates in an unbound state for use as roadbase. Their laboratories are testing aggregates for shear strengths. Pilot-scale trials are being linked to the results of laboratory studies to establish levels of shear strength required for satisfactory subbase performance. Also, simple compaction tests are being developed for use in concrete and bituminous mixes.

Recent modifications of British Standards for bituminous roadbase materials will permit, in future design procedures, a wider range of aggregates than at present and the composition will be related to performance requirements.

The compositions of most bituminous-coated road materials were covered in British Standards and bituminous mixes of other compositions were included in the Department of Environment's Specification for Roads and Bridges. These standards contained some mixes which were seldom used and materials of very similar composition were found in the various standards. Because of these complexities and changes in use and road-loading conditions, one set of British Standards covering all types of bituminous-coated road materials have been adopted.[14]

A single screw sand and gravel suction dredge, built by Ailsa Shipbuilding Co., Ltd., has been delivered to British Dredging, Ltd. The 4,425-ton vessel is designed to pump 2,200 tons of dredged material per hour at depths of 75 feet. However, the vessel can operate at depths of 148 feet when necessary. The dredged material is processed and stored in the hold. On every voyage the dredge can produce 3,556 tons of drained sand and gravel.[15]

Britain's largest producer of aggregates has installed radar on their pit tugs used to push sand and gravel laden barges from the extracting area to the processing plant. Because of the company's policy on reclamation, islands have been left in the pit. The prime objective of the radar is to prevent the tugs from running aground. On a foggy day losses from running aground have been as high as 800 tons of production. Each barge carries about 150 tons. With radar, the tug operators can home in on a selected guide post and deliver their cargo safely to the plant.[16]

Yugoslavia.—Gammerler & Co. delivered a complete aggregate processing plant for a ready-mix concrete operation in the center of Belgrade. The plant was specially designed to fit a limited space on the right bank of the Danube. The sand and gravel is delivered in ships with a 70,000-cubic-feet carrying capacity. Unloading is done by floating unloaders. The unloaders are equipped with scoop wheels that can be lowered into the ships. On land the material is fed from the stockpile to the processing plant. The processing plant consists of six steel silos, five with a capacity of about 7,000 cubic feet and one with a capacity of 10,000 cubic feet, a jaw crusher for oversized material, two double-deck screens, a 6-inch centrifugal pump, and 8-inch hydrocyclones have been installed for sand recovery.[17]

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[13] Ironman, Ralph. Swedes Legislate Total Plant Enclosures. Rock Products, v. 77, No. 4, April 1974, pp. 54–55.

[14] Peattie, K. R. Developments in Coated Materials. Quarry Management and Products, v. 1, No. 4, September 1974, pp. 137–144.

[15] Cement Lime and Gravel. New Dredging Vessel Launched. V. 49, No. 2, February 1974, p. 42.

[16] Ironman, Ralph. European Editor International Report. Rock Products, v. 77, No. 11, November 1974, p. 28.

TECHNOLOGY

Macomb County, Mich., highway officials are testing a thinner, less complicated pavement design expected to cut construction costs by 19% on 4 miles of roadway in metropolitan Detroit. The design has a 6-inch pozzolan base and a 7-inch nonreinforced concrete overlay. Conventional, comparable roadways have a 6-inch sand base, 4 inches of crushed stone, and 9 inches of concrete. The new design has no expansion joints; contraction joints are unpinned, and skewed and sawed at intervals of 15 to 18 feet. The pozzolan is a mixture of fly ash, lime, and sand aggregate. This slowly forms concrete when about 10% moisture is added. The concrete offers a savings in material costs. It is not known what effect the elimination of expansion joints will have on costs. Unpinned contraction cuts have been used since 1970, but expansion joints were eliminated this year for the first time. The overall effect of the test design on costs will not be known until next year. The design life of the pavement is 20 years.[18]

Use of gravel-bed filters for dust collection is increasing. There were 26 cement, lime, and refractory companies using high-purity quartz gravel to clean hot abrasive dusts. Gravel-bed filters at these operations have been found to be highly efficient, having low operation costs and needing little maintenance. They operate at temperatures up to 900° F. The gravel-bed itself is relatively unaffected by temperatures up to 2,000° F. Although the filters have been used mainly for dust separation in cement plants and in the lime industry, they find some application in other industries. The filter medium is made up of uniformly sized, almost round, rough-textured 99% silica gravel. The gravel ranges in size from one-half to 4 millimeters. The gravel-bed filter in the United States is built in accordance with an exclusive license agreement between Gesellschaft für Entstäubungsanlagen (GfE) of Münich, West Germany, and Rexnord, Inc., of Milwaukee, Wis.[19]

The Las Vegas Paving Co. is pilot testing an 80-ton-per-hour portable unit which will economically process and recycle asphalt rubble. The rubble would become a source of usable raw material in road-building. Patent applications have been filed covering the Recycle Machinery, Inc. (RMI) Roadrunner and its operation. The inventors claim the process is profitable with no dust or fume problems. They estimate that every thousand tons of broken asphalt pavement contains about 950 tons of crushed and graded specification aggregates and about 285 barrels of asphalt. A petroleum-based softening agent is an essential ingredient and a 1% to 2% addition of fresh asphalt is required. New aggregates are usually added to fill gradations. Overall savings are said to be up to 35%.[20]

A program designed to reduce dust has also resulted in savings in the grading and wetting of heavily traveled gravel surfaced plant roads. Cost savings have been running $223 per day at one location and the dust stirred up by trucks is virtually eliminated. Coherex, manufactured by Vitco Chemical Corp., Golden Bear Div., is a stable, concentrated cold water emulation of petroleum oils and resins. The material requires no heat and can be diluted with cold water, including seawater. The program involves continuous daily spraying for about 3 weeks. After this period the dirt and gravel surface becomes relatively smooth and dust free and requires only one daily spraying. Conrock Co. has found this program successful in controlling dust at their Irwindale plant in California.[21]

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[17] Ironman. Ralph. European Editor International Report. Rock Products, v. 77, No. 2, February 1977, p. 88.

[18] Engineering News Record. Test on Thinner Road Design May Cut Costs by 19%. V. 1973, No. 21, Nov. 14, 1974, p. 15.

[19] Environmental Science & Technology. Gravel-Bed Filters Clean Industries' Hot and Abrasive Dusts. V. 8, No. 7, July 1974, pp. 600–601.

Schueler, J. A. Gravel-Bed Filters in General Portland, Inc, Tampa, Florida Plant. Pres. at Ninth Internat. Rock Products Cement Seminar, Dec. 4, 1973, Chicago, Ill.

[20] Roads & Streets. Bituminous Old Asphalt can be Valuable Raw Material. V. 117, No. 6, June 1974, pp. 105–106.

At the Bureau of Mines Tuscaloosa Metallurgy Research Laboratory, experiments are being conducted on the reclamation and beneficiation of foundry mold materials. The objective is to develop methods for reclaiming foundry sands by physical and pyrolytic beneficiation techniques. Also, research is being conducted on controlled expansion of foundry sands from low-grade olivine and on the suitability of other mineral products for foundry use. The Tuscaloosa Laboratory has been engaged in the development of structural materials utilizing reclaimed glass as the principal component.

A new handling method has been developed which allows aragonite, a pearly calcareous sand, to be used for beach restoration. The new method was developed by Marcona Ocean Industries of San Francisco. An 8-ton capsule assisted by two high-pressure water jets and equipped with a discharge pump and a specially designed eductor valve, can pump 400 tons of aragonite slurry ashore in an hour. Aragonite, the sand which forms most of the white beaches of the Bahamas Archipelago, has been mined from the ocean bottom and sold to the glass, cement, limestone, and carbonate beverages industries.[22]

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[21] Roads & Streets. Dust Control Program Saves Grading, Watering Costs. V. 117, No. 5, May 1974, p. 114.

[22] World Dredging and Marine Construction. New Method Created for Sand Slurries. V. 10, No. 12, October 1974, p. 39.

Table 2.—Construction aggregate and industrial sand and gravel sold or used by commercial producers in the United States
(Thousand short tons and thousand dollars)

	1973		1974[1]	
	Quantity	Value	Quantity	Value[2]
Construction aggregate:				
Processed sand and gravel	720,204	1,033,810	703,150	1,166,721
Unprocessed sand and gravel	97,627	70,680	212,610	112,771
Industrial:				
Sand	28,974	110,065	28,024	135,357
Gravel			1,046	3,342
Total	846,805	[3]1,214,559	944,830	1,418,191

[1] Data not directly comparable with those of previous years because of changes in canvass form.
[2] Unit value of construction aggregate may be higher than unit value of sand or gravel.
[3] Data does not add to total shown because of independent rounding.

Table 3.—Construction aggregate and industrial sand and gravel produced by Federal, State, or County crews from their own operations for sale or use
(Thousand short tons and thousand dollars)

	1973		1974[1]	
	Quantity	Value	Quantity	Value[2]
Cocnstruction aggregate:				
Processed sand and gravel	136,824	144,811	23,868	25,763
Unprocessed sand and gravel			10,056	7,117
Industrial:				
Sand	--	--	--	--
Gravel	--	--	--	--
Total	136,824	144,811	33,924	32,880

[1] Data not directly comparable with those of previous years because of changes in canvass form.
[2] Unit value of construction aggregate may be higher than unit value of sand or gravel.

Table 4.—Construction aggregate sold or used by producers in the United States for commercial or publicly funded construction projects, or products

(Thousand short tons and thousand dollars)

	1973				1974[1]			
	Commercial		Publicly funded projects		Commercial		Publicly funded projects	
	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value[2]
Processed:								
Concrete aggregate, (including use in ready-mixed concrete):								
Nonresidential and residential construction	689,702	982,723	110,389	129,409	214,840	376,890	10,001	16,974
Highway and bridge construction					29,389	50,472	44,128	72,169
Other construction (dams, waterworks, airports, etc.)					13,242	23,646	6,373	10,834
Concrete products (cement blocks, bricks, pipe, etc.)					68,259	125,002	3,504	6,465
Bituminous paving (asphalt and tar paving)					81,053	129,487	62,708	101,897
Roadbase and subbase					71,123	110,323	76,220	105,811
Fill[3]	82,106	61,440	15,521	9,243	26,008	32,277	5,283	6.133
Other[4]	46,023	60,330	10,914	6,158	11,647	19,408	3,240	4,695
Unprocessed:								
Fill	--	--	--	--	99,601	58,006	10,065	7,223
Roadbase and subbase	--	--	--	--	97,950	46,123	15,050	8,536
Total[5]	817,831	1,104,493	136,824	144,811	713,112	971,635	236,572	340,737

[1] Data not directly comparable with those of previous years because of changes in canvass form.
[2] Unit value of construction aggregate may be higher than unit value of sand or gravel.
[3] Includes unprocessed sand and gravel (1973).
[4] Includes railroad ballast, miscellaneous and some unprocessed sand and gravel (1973).
[5] Data may not add to totals shown because of independent rounding.

Table 5.—Sand and gravel production by State

(Thousand short tons and thousand dollars)

State	1973		1974	
	Quantity	Value	Quantity	Value
Alabama	9,805	13,870	12,454	19,120
Alaska	14,999	19,913	117,752	52,788
Arizona	27,440	38,503	23,417	41,906
Arkansas	12,465	20,625	14,878	29,922
California	117,470	176,286	105,191	176,213
Colorado	33,767	45,493	23,793	39,674
Connecticut	7,806	12,788	6,345	11,272
Delaware	3,408	3,678	2,396	3,783
Florida	20,167	21,415	24,372	33,400
Georgia	4,976	6,781	4,989	9,639
Hawaii	753	2,012	990	2,379
Idaho	8,393	10,246	7,665	10,484
Illinois	43,649	62,029	42,705	68,566
Indiana	27,731	35,015	26,077	35,656
Iowa	19,950	25,541	17,091	26,104
Kansas	13,261	12,663	11,687	13,388
Kentucky	10,331	14,627	8,710	12,887
Louisiana	13,748	21,165	12,341	27,781
Maine	13,583	10,304	8,755	10,673
Maryland	12,845	29,625	11,690	29,386
Massachusetts	18,743	26,910	17,334	26,565
Michigan	62,407	73,972	60,027	82,617
Minnesota	37,935	39,438	36,720	42,370
Mississippi	14,251	17,383	14,439	19,487
Missouri	10,879	16,950	10,933	19,462
Montana	11,694	13,819	4,242	6,126
Nebraska	15,906	18,366	13,231	17,727
Nevada	12,448	14,614	8,736	14,515
New Hampshire	7,795	8,597	6,126	8,223
New Jersey	19,040	43,098	17,924	47,292
New Mexico	10,641	15,753	7,413	10,605
New York	29,544	41,396	30,614	46,652
North Carolina	15,897	19,327	12,784	20,844
North Dakota	6,011	6,021	4,991	6,211
Ohio	48,987	69,982	41,353	68,258
Oklahoma	12,154	14,941	8,708	13,772
Oregon	22,802	32,751	18,558	30,948
Pennsylvania	20,576	42,830	18,071	45,181
Rhode Island	2,429	3,095	2,784	4,605
South Carolina	8,179	12,628	7,380	13,054
South Dakota	13,963	16,587	9,028	9,720
Tennessee	12,010	20,145	10,702	19,476
Texas	38,546	60,706	42,466	81,364
Utah	15,410	15,986	11,578	12,985
Vermont	4,041	3,581	2,394	3,588
Virginia	14,511	26,246	14,314	29,270
Washington	27,935	30,132	22,842	35,030
West Virginia	5,893	16,257	5,382	16,018
Wisconsin	40,250	43,647	28,850	34,577
Wyoming	6,201	11,635	5,532	9,508
Total[1]	983,629	1,359,370	978,754	1,451,071

[1] Data may not add to totals shown because of independent rounding.

Table 6.—Construction sand and gravel in

(Thousand short tons

State	Concrete aggregate							
	Nonresidential and residential construction				Highway and bridge construction			
	Commercial		Publicly funded projects		Commercial		Publicly funded projects	
	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value
Alabama	2,398	3,865	47	137	195	339	1,006	1,928
Alaska	168	569	W	W	49	138	2	6
Arizona	6,566	11,285	634	907	633	1,107	658	965
Arkansas	5,249	10,536	153	263	452	879	372	736
California	29,346	49,079	1,769	2,815	5,727	9,165	2,386	3,696
Colorado	4,625	9,346	645	872	287	612	1,023	1,552
Connecticut	1,378	2,977	85	232	150	229	43	83
Delaware	227	602	W	W	W	W	--	--
Florida	6,746	9,382	W	W	1,075	1,816	1,849	2,111
Georgia	2,394	3,322	23	29	272	396	2	W
Hawaii	353	884	--	--	--	--	14	--
Idaho	1,256	2,348	W	W	233	456	230	269
Illinois	10,357	14,166	68	91	2,348	3,482	1,893	3,136
Indiana	5,590	8,228	156	235	622	978	1,860	2,711
Iowa	3,187	5,237	63	76	896	1,677	1,626	3,167
Kansas	2,857	3,732	53	66	504	520	1,643	1,844
Kentucky	3,519	5,294	--	--	232	445	689	910
Louisiana	4,733	11,212	W	W	469	854	1,091	2,015
Maine	605	1,107	554	753	152	327	1,753	2,454
Maryland	5,002	13,335	175	564	228	637	1,150	3,039
Massachusetts	4,714	9,775	241	405	432	956	302	670
Michigan	11,675	18,569	116	102	893	1,259	2,926	3,503
Minnesota	6,112	9,631	301	514	1,396	2,095	959	1,405
Mississippi	2,376	3,554	34	87	684	1,092	710	1,213
Missouri	3,468	4,820	98	210	467	741	501	725
Montana	563	1,386	58	182	70	153	219	269
Nebraska	1,735	2,035	100	142	894	1,356	2,795	3,682
Nevada	1,958	3,677	55	146	65	103	259	547
New Hampshire	1,074	2,086	59	95	291	480	115	193
New Jersey	3,773	7,564	W	W	908	2,026	345	698
New Mexico	1,903	3,775	99	191	83	209	59	93
New York	10,135	17,960	517	920	1,246	2,442	915	1,729
North Carolina	3,335	5,647	51	66	288	596	249	376
North Dakota	848	2,227	W	W	89	144	17	32
Ohio	9,983	16,881	994	1,541	659	1,107	2,027	3,626
Oklahoma	3,298	4,714	85	87	350	584	432	595
Oregon	3,149	6,018	261	601	530	802	721	1,258
Pennsylvania	5,639	12,977	195	440	749	1,939	1,559	3,510
Rhode Island	344	516	--	--	37	97	W	W
South Carolina	4,617	7,535	W	W	126	139	--	--
South Dakota	737	1,193	2	W	406	652	691	1,000
Tennessee	1,850	3,503	184	289	426	946	302	535
Texas	17,348	34,044	401	670	975	2,008	4,340	8,385
Utah	2,262	2,743	31	37	204	307	437	724
Vermont	484	888	W	W	56	197	90	114
Virginia	3,902	8,374	962	1,886	865	1,623	622	1,713
Washington	5,265	8,366	185	323	399	732	321	707
West Virginia	761	1,499	W	W	W	W	W	W
Wisconsin	4,017	6,088	160	192	1,126	1,285	1,322	1,656
Wyoming	960	2,351	13	33	48	70	357	668
Concealed	--	--	372	778	91	258	1,255	1,925
Total [2]	214,840	376,890	10,002	16,974	29,389	50,472	44,126	72,169

See footnotes at end of table.

the United States in 1974, by State and by use [1]
and thousand dollars)

(including use in ready mixed concrete)

Other construction (dams, waterworks, airports, etc.)				Concrete products (cement blocks, bricks, pipe, etc.)				Bituminous paving (asphalt and tar paving)			
Commercial		Publicly funded projects		Commercial		Publicly funded projects		Commercial		Publicly funded projects	
Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value
327	586	62	W	1,730	3,015	W	W	906	1,710	765	1,241
50	139	226	1,116	108	291	--	--	130	259	5,494	9,113
211	616	W	W	790	1,769	W	W	1,522	2,384	2,274	5,774
234	480	61	81	1,388	2,738	W	W	1,558	2,739	755	1,398
2,643	4,274	446	940	5,942	9,954	740	1,123	11,148	18,659	7,585	13,587
193	371	127	212	628	1,159	W	W	1,406	3,139	2,006	3,079
203	403	W	W	1,015	1,853	31	68	719	1,566	221	568
W	W	--	--	261	632	W	W	W	W	--	--
195	301	68	116	3,749	5,141	--	--	529	672	W	W
105	180	--	--	1,224	1,818	17	26	108	491	--	--
14	17	--	--	17	25	--	--	W	W	--	--
396	749	153	227	322	820	40	51	318	408	522	543
548	788	136	192	2,875	5,505	74	113	5,332	8,770	1,493	2,287
295	418	93	134	1,547	2,089	24	34	6,876	10,495	1,791	2,568
170	318	15	29	863	1,510	52	99	3,606	4,300	1,734	1,934
166	289	W	W	534	611	36	37	760	1,005	584	690
139	234	320	407	382	670	--	--	1,081	1,454	160	279
210	365	W	W	1,438	3,559	82	164	602	1,306	1,022	2,359
65	217	742	757	325	656	--	--	489	832	1,181	1,299
163	405	W	W	1,862	4,650	W	W	642	1,312	864	2,486
278	646	85	143	1,098	2,069	85	93	1,281	2,133	509	974
731	987	282	293	3,243	5,457	123	160	3,328	4,681	4,190	5,489
355	569	21	39	2,835	4,453	W	W	3,787	3,706	3,772	3,995
80	132	75	148	1,505	2,433	79	153	845	1,405	1,376	1,954
52	78	84	136	642	924	5	5	994	1,629	372	547
58	126	21	45	208	371	13	27	169	292	294	386
242	276	53	52	1,358	1,750	W	W	717	1,109	1,141	1,422
30	60	W	W	88	147	--	--	829	1,186	778	1,511
88	165	W	W	254	447	2	W	774	1,219	225	409
392	881	W	W	4,137	10,881	51	127	1,183	2,626	540	988
45	116	20	31	399	1,094	W	W	351	522	1,481	1,901
475	975	349	416	2,205	4,268	255	446	2,222	4,503	857	1,642
181	339	3	5	1,945	2,924	W	W	1,033	1,950	327	530
56	106	W	W	72	212	--	--	509	446	493	585
227	391	446	863	3,333	5,720	218	351	10,283	16,299	2,607	4,514
179	268	195	356	429	526	--	--	289	423	26	43
295	507	18	39	813	1,708	--	--	2,317	3,860	1,366	2,649
257	822	129	292	2,437	5,688	W	W	1,218	2,738	2,012	5,487
19	45	--	--	422	627	--	--	497	1,075	226	359
40	40	--	--	466	587	--	--	198	171	W	26
71	101	--	--	362	628	14	31	332	462	981	941
311	648	W	W	2,029	3,971	W	W	609	969	283	286
669	1,215	229	432	3,113	5,528	66	88	2,482	4,817	2,589	4,908
148	211	22	31	817	1,071	32	44	1,161	1,576	651	828
44	153	8	16	146	324	16	34	232	454	137	170
100	232	W	W	1,755	4,555	547	1,526	520	984	159	281
645	896	194	473	1,305	2,505	114	168	1,682	2,837	1,669	2,905
W	W	--	--	W	W	--	--	W	W	W	W
467	607	180	156	2,652	3,261	240	370	1,917	1,950	2,748	2,724
310	704	80	84	147	277	--	--	1,412	1,637	992	1,796
65	197	1,481	2,572	1,045	2,127	558	1,130	152	329	1,457	2,490
13,241	23,646	6,374	10,834	68,258	125,003	3,504	6,465	81,056	129,487	62,708	101,897

Table 6.—Construction sand and gravel in the United

(Thousand short tons

State	Roadbase and subbase				Fill			
	Commercial		Publicly funded projects		Commercial		Publicly funded projects	
	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value
Alabama	937	1,118	318	496	49	62	--	--
Alaska	137	278	6,156	10,124	116	224	--	--
Arizona	3,246	4,535	2,830	5,969	817	1,530	194	266
Arkansas	378	570	519	980	264	285	169	144
California	8,150	12,993	10,988	19,700	4,970	6,525	718	923
Colorado	5,097	9,064	3,344	4,762	476	766	172	221
Connecticut	737	1,232	48	109	182	214	27	41
Delaware	W	W	--	--	W	W	--	--
Florida	755	1,227	1,289	2,180	1,236	1,101	W	W
Georgia	W	W	--	--	83	145	--	--
Hawaii	121	290	--	--	--	--	--	--
Idaho	603	734	831	851	396	291	105	190
Illinois	3,274	5,639	2,150	3,492	2,281	3,408	322	511
Indiana	1,210	1,656	1,136	1,528	989	1,056	165	192
Iowa	1,028	1,621	2,015	2,999	661	885	19	29
Kansas	567	613	632	623	1,019	855	70	71
Kentucky	1,530	2,232	71	123	98	173	--	--
Louisiana	391	1,069	678	965	77	167	W	W
Maine	168	313	805	757	217	145	739	377
Maryland	306	486	327	666	129	196	W	W
Massachusetts	1,142	1,798	440	602	773	813	55	112
Michigan	8,322	12,489	9,632	9,663	870	1,023	379	362
Minnesota	3,200	3,615	5,891	5,372	1,211	1,438	108	141
Mississippi	2,926	4,299	818	1,294	12	24	W	W
Missouri	1,426	1,739	527	800	202	321	109	187
Montana	392	725	463	682	54	77	86	90
Nebraska	1,141	1,925	1,693	2,367	543	556	96	71
Nevada	835	1,204	1,441	1,941	286	307	105	312
New Hampshire	392	652	693	262	148	187	--	--
New Jersey	521	1,281	229	470	217	328	--	--
New Mexico	497	712	1,314	1,083	180	232	94	57
New York	1,340	2,018	712	1,066	543	607	58	21
North Carolina	560	1,019	387	689	69	107	--	--
North Dakota	322	285	1,771	1,313	111	169	96	58
Ohio	2,613	4,336	937	1,517	1,437	2,248	235	335
Oklahoma	156	232	78	70	222	145	W	W
Oregon	2,276	4,032	3,041	5,455	787	1,108	130	162
Pennsylvania	778	1,628	696	1,147	160	346	42	89
Rhode Island	131	288	105	164	107	187	W	W
South Carolina	W	W	12	12	64	58	--	--
South Dakota	1,171	990	2,211	2,032	73	69	82	78
Tennessee	734	1,422	791	881	172	229	W	W
Texas	2,451	4,600	1,121	1,816	581	780	30	47
Utah	1,452	1,835	1,030	1,244	119	180	189	143
Vermont	156	316	101	99	18	18	--	--
Virginia	1,064	1,995	555	1,321	1,263	1,075	--	--
Washington	2,253	3,994	1,284	2,122	482	655	77	85
West Virginia	50	W	7	25	W	W	--	--
Wisconsin	3,755	3,871	3,563	3,215	936	695	293	166
Wyoming	253	565	540	815	293	283	W	W
Concealed	182	796	--	--	17	86	319	653
Total [2]	71,122	110,323	76,220	105,811	26,007	32,277	5,288	6,134

W Withheld to avoid disclosing individual company confidential data; included with "Concealed."

[1] Data not directly comparable with those of previous years because of changes in canvass form.

[2] Data may not add to totals shown because of independent rounding.

States in 1974, by State and use [1]—Continued
and thousand dollars)

Other				Unprocessed sand and gravel							
				Fill				Roadbase and subbase			
Commercial		Publicly funded projects		Commercial		Publicly funded projects		Commercial		Publicly funded projects	
Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value
784	1,674	W	W	400	448	491	127	528	419	928	320
281	W	320	222	35,730	7,429	2,191	3,366	65,019	17,069	1,569	2,065
114	309	W	W	849	1,236	132	49	304	241	W	W
73	102	--	--	381	199	217	103	416	329	1,724	815
724	1,292	123	211	3,612	2,904	1,844	1,033	3,394	4,874	749	235
1,158	1,833	195	354	680	600	664	276	515	415	400	287
175	303	35	51	780	798	W	W	447	477	--	--
--	--	--	--	359	564	--	--	W	W	--	--
--	--	--	--	4,161	2,961	--	--	943	975	W	W
W	W	--	--	176	146	--	--	76	W	--	--
W	W	--	--	W	W	--	--	4	W	--	--
420	731	2	5	295	228	158	67	662	607	376	130
747	1,218	22	49	4,666	4,623	--	--	2,034	2,356	--	--
580	550	64	99	2,532	1,677	76	37	182	160	W	W
128	247	16	25	718	849	49	15	51	75	W	W
153	185	55	62	243	180	108	71	319	139	824	427
174	272	--	--	225	178	--	--	W	W	--	--
130	317	--	--	227	250	9	3	737	1,190	--	--
54	128	180	90	500	270	--	--	223	182	--	--
W	W	--	--	142	147	5	1	424	754	40	12
446	822	134	257	2,780	1,820	W	W	2,435	1,715	--	--
402	628	92	108	3,639	1,850	1,256	431	1,445	1,091	1,317	431
415	420	313	348	2,708	1,449	784	238	1,270	559	911	290
235	295	--	--	76	58	--	--	1,771	927	758	267
239	387	--	--	116	93	--	--	210	97	31	34
98	141	5	5	407	364	W	W	690	560	317	159
134	178	6	11	238	371	W	W	9	9	274	188
40	60	--	--	341	306	10	13	118	46	303	87
509	949	115	182	922	636	--	--	429	204	--	--
45	101	42	69	1,938	1,522	--	--	308	321	--	--
6	28	43	80	74	97	135	81	285	128	327	148
406	809	451	604	5,403	3,861	283	149	1,460	1,476	659	195
87	177	--	--	1,560	1,298	266	239	1,310	967	78	W
11	15	62	W	356	360	73	73	80	53	--	--
466	761	21	84	3,224	2,976	217	153	535	595	40	57
W	W	19	6	1,366	684	--	--	369	212	264	219
304	531	46	115	1,473	1,467	17	W	513	360	495	237
190	451	70	111	355	451	W	W	305	219	W	W
27	87	W	W	80	47	--	--	518	370	--	--
--	--	--	--	453	173	W	W	536	391	W	9
218	298	209	238	555	481	51	17	702	438	162	73
116	204	W	W	310	302	92	41	1,139	863	331	130
368	783	9	33	3,736	2,254	56	31	353	298	159	35
285	327	11	12	1,604	714	263	230	823	559	--	--
W	W	28	22	469	382	4	3	238	183	84	28
28	37	W	W	1,401	1,387	--	--	109	59	--	--
284	565	W	W	4,982	4,573	69	26	1,341	1,062	15	8
--	--	--	--	W	W	14	30	--	--	11	17
432	500	146	135	1,895	1,248	409	151	834	391	381	101
1	1	W	W	75	92	--	--	100	123	--	--
158	696	405	1,164	390	1,002	125	170	1,441	1,586	1,525	1,585
11,647	19,408	3,241	4,695	99,602	58,000	10,068	7,224	97,949	46,124	15,052	8,539

Table 7.—Industrial sand and gravel sold or used by all producers in the United States

(Thousand short tons and thousand dollars)

	1973		1974	
	Quantity	Value	Quantity	Value
Unground sand:				
Molding	7,446	25,540	7,462	33,328
Glass	10,158	41,485	10,040	46,632
Blast	1,195	6,133	2,136	11,281
Grinding and polishing	359	1,152	99	558
Fire or furnace	1,005	3,214	399	1,752
Engine	835	2,042	524	2,073
Filtration	283	1,368	305	1,639
Metallurgical	--	--	364	1,286
Oil (hydrafrac)	352	1,773	383	3,447
Other	2,748	8,940	2,107	8,824
Total [1]	24,381	91,648	23,820	110,821
Ground sand:				
Filter	164	1,707	208	2,865
Chemical	76	508	404	1,719
Enamel	42	406	W	W
Abrasives	235	2,142	325	2,823
Foundry	2,928	6,917	2,095	8,627
Glass	726	3,679	850	5,004
Pottery, porcelain, tile	169	1,706	136	1,552
Other	253	1,353	186	1,944
Total [1]	4,593	18,418	4,204	24,536
Gravel:				
Metallurgical	--	--	1,004	3,141
Other	--	--	43	201
Total [1]	--	--	1,046	3,342
Grand total [1]	28,974	110,065	29,070	138,699

W Withheld to avoid disclosing individual company confidential data; included with "Other."

[1] Data may not add to totals shown because of independent rounding.

Table 8.—Industrial sand and gravel sold or used by all producers in the United States in 1973 and 1974, by State

(Thousand short tons and thousand dollars)

State	1973 [1]		1974 [2]	
	Quantity	Value	Quantity	Value
Alabama	366	809	503	1,395
Alaska	(3)	(3)	--	--
Arizona	W	W	179	897
Arkansas	W	W	W	W
California	2,139	10,931	2,185	12,231
Colorado	W	W	W	W
Connecticut	W	W	--	--
Florida	701	2,837	727	3,940
Georgia	W	W	358	2,430
Hawaii	(3)	(3)	--	--
Idaho	92	329	323	764
Illinois	1,937	5,852	2,084	8,738
Indiana	W	W	266	804
Iowa	W	W	195	1,012
Kansas	W	W	203	918
Kentucky	W	W	49	202
Louisiana	266	1,388	282	1,648
Maine	W	W	W	W
Maryland	W	W	--	--
Massachusetts	199	798	W	W
Michigan	5,135	11,152	5,167	14,039
Minnesota	W	W	W	W
Mississippi	W	W	W	W
Missouri	1,027	4,440	1,390	5,991
Montana	7	10	--	--
Nebraska	W	W	50	266
Nevada	326	1,613	297	1,381
New Hampshire	--	--	W	W
New Jersey	4,253	19,466	3,247	17,272

See footnotes at end of table.

Table 8.—Industrial sand and gravel sold or used by all producers in the United States in 1973 and 1974, by State—Continued

(Thousand short tons and thousand dollars)

State	1973 [1]		1974 [2]	
	Quantity	Value	Quantity	Value
New York	263	1,178	124	544
North Carolina	692	2,104	1,049	3,869
Ohio	579	2,635	857	3,954
Oklahoma	910	3,783	907	4,572
Oregon	83	193	W	W
Pennsylvania	1,955	6,619	1,099	6,508
Rhode Island	W	W	W	W
South Carolina	606	3,084	773	3,884
Tennessee	889	3,443	758	3,606
Texas	1,113	4,652	1,391	8,595
Utah	W	W	W	W
Vermont	W	W	W	W
Virginia	297	1,486	405	2,072
Washington	W	W	239	1,966
West Virginia	W	W	W	W
Wisconsin	1,209	4,218	1,376	5,813
Wyoming	--	--	1	6
Concealed	3,930	17,045	2,586	19,382
Total	28,974	110,065	29,070	138,699

W Withheld to avoid disclosing individual company confidential data; included with "Concealed."

[1] Includes only industrial sand.

[2] Includes industrial sand and gravel.

[3] Less than ½ unit.

Table 9.—Number of, and production at construction sand and gravel and industrial sand and gravel operations, by size

Size	1973				1974											
	Construction-industrial				Construction				Industrial				Construction-industrial			
	Operations		Production		Operations		Production		Operations		Production		Operations		Production	
	Number	Percent of total	Thousand short tons	Percent of total	Number	Percent of total	Thousand short tons	Percent of total	Number	Percent of total	Thousand short tons	Percent of total	Number	Percent of total	Thousand short tons	Percent of total
Less than 25,000	1,655	29.1	18,054	2.1	2,149	31.8	21,387	2.3	24	20.3	229	1.0	13	12.9	178	0.6
25,000 to 50,000	884	15.6	32,244	3.7	1,141	16.9	41,439	4.5	14	11.9	536	2.4	8	7.9	308	1.0
50,000 to 100,000	1,053	18.5	75,822	9.0	1,262	18.7	90,435	9.8	22	18.6	1,516	6.7	17	16.8	1,228	4.2
100,000 to 200,000	904	15.9	129,084	15.2	1,085	16.1	152,907	16.6	18	15.2	2,578	11.5	27	26.7	3,915	13.4
200,000 to 300,000	450	7.9	109,976	13.0	436	6.5	105,074	11.4	16	13.6	3,763	16.8	8	7.9	1,890	6.4
300,000 to 400,000	230	4.1	79,468	9.4	208	3.1	70,924	7.7	10	8.5	3,399	15.1	6	5.9	2,115	7.2
400,000 to 500,000	134	2.4	59,977	7.1	135	2.0	60,534	6.6	3	2.5	1,430	6.4	2	2.0	952	3.2
500,000 to 600,000	78	1.4	42,472	5.0	97	1.4	53,013	5.7	5	4.2	2,774	12.4	5	5.0	2,740	9.4
600,000 to 700,000	79	1.4	51,306	6.1	59	.9	38,043	4.1	1	.9	600	2.7	1	1.0	653	2.2
700,000 to 800,000	48	.8	35,345	4.2	44	.6	32,825	3.6	1	.9	741	3.3	3	3.0	2,269	7.8
800,000 to 900,000	42	.7	35,708	4.2	21	.3	17,701	1.9	--	--	--	--	3	3.0	2,504	8.6
900,000 to 1,000,000	24	.4	22,635	2.7	31	.5	28,428	3.1	2	1.7	1,911	8.5	1	1.0	908	3.1
1,000,000 and over	100	1.8	154,713	18.3	779	1.2	209,295	22.7	2	1.7	2,975	13.2	7	6.9	9,634	32.9
Total	5,681	100.0	[1] 846,805	100.0	7,447	100.0	922,005	100.0	118	100.0	22,452	100.0	101	100.0	29,294	100.0

[1] Data does not add to total shown because of independent rounding.

Table 10.—Sand and gravel sold or used in the United States by method of transportation to customer or site of use

	1973		1974	
	Thousand short tons	Percent of total	Thousand short tons	Percent of total
Truck	904,864	92	856,996	88
Rail	41,641	4	54,158	5
Waterway	32,686	3	24,421	2
Not shipped, used at site	--	--	36,382	4
Unspecified	4,438	1	6,797	1
Total	983,629	100	978,754	100

Table 11.—Number of processing plants associated with sand and gravel operations in 1974 in the United States[1]

State	Number of operations	Plant associated with wet or dry pit on land				Plant associated with dredge		
		Plant at pit site		Plant not at pit site	No plant	Plant on board	Plant on land	No plant
		Stationary	Portable	Stationary or portable				
Alabama	84	32	7	--	18	3	9	1
Alaska	143	24	34	24	119	1	1	--
Arizona	149	64	65	10	9	--	--	1
Arkansas	276	50	65	26	115	5	19	--
California	390	231	90	8	46	4	8	2
Colorado	200	57	115	3	14	7	3	--
Connecticut	71	43	22	--	4	--	--	--
Delaware	13	10	--	--	6	--	--	--
Florida	69	17	2	--	8	3	38	3
Georgia	41	28	8	1	5	--	2	--
Hawaii	9	3	7	--	1	--	--	--
Idaho	104	42	45	2	14	1	2	1
Illinois	229	73	104	2	22	6	15	1
Indiana	187	91	33	1	31	3	30	--
Iowa	228	69	98	2	11	12	30	--
Kansas	157	31	28	--	37	10	38	5
Kentucky	42	14	15	2	1	8	7	--
Louisiana	70	18	3	3	6	10	34	2
Maine	65	33	23	1	12	--	--	--
Maryland	55	32	8	13	4	--	2	--
Massachusetts	140	92	21	5	20	1	1	3
Michigan	429	128	226	6	51	8	20	1
Minnesota	402	127	216	16	42	--	4	1
Mississippi	61	27	3	--	11	5	17	--
Missouri	88	31	15	2	5	12	20	1
Montana	64	30	26	2	8	--	--	--
Nebraska	238	39	28	3	13	28	127	8
Nevada	85	34	37	3	13	--	--	--
New Hampshire	53	23	20	4	6	--	--	--
New Jersey	91	48	12	4	15	--	14	--
New Mexico	120	37	68	3	14	--	--	2
New York	248	127	57	10	49	1	6	--
North Carolina	153	28	24	2	81	--	17	2
North Dakota	90	27	51	1	11	--	1	--
Ohio	348	210	42	10	64	3	16	4
Oklahoma	107	25	9	1	30	1	39	4
Oregon	165	69	54	8	23	1	7	1
Pennsylvania	111	79	17	3	4	3	6	2
Rhode Island	23	17	3	2	3	--	--	--
South Carolina	45	20	2	--	12	--	12	--
South Dakota	175	29	114	3	26	--	--	--
Tennessee	74	35	8	--	14	6	9	--
Texas	180	106	26	12	18	3	9	1
Utah	101	32	55	2	14	--	--	--
Vermont	53	13	18	1	22	--	--	--
Virginia	129	46	18	1	51	2	5	4
Washington	220	77	76	4	55	--	--	2
West Virginia	14	5	4	--	4	5	--	--
Wisconsin	315	91	175	18	27	1	2	1
Wyoming	68	17	40	5	7	--	1	--
Total	6,967	2,631	2,237	229	1,196	148	571	53

[1] Some operations have more than one plant on location for processing mined material from a single pit.

Table 12.—Sand and gravel production

(Thousand short tons

State	Dry pit on land			Wet pit on land			Not navigable		
	Quantity	Value	Number of operations	Quantity	Value	Number of operations	Quantity	Value	Number of operations
Alabama	5,426	7,253	36	3,107	4,885	21	W	W	4
Alaska	22,510	18,225	91	7,455	5,942	31	W	W	2
Arizona	7,309	13,970	64	W	W	2	12,285	18,478	45
Arkansas	6,776	15,784	148	637	1,055	11	1,221	1,345	11
California	68,191	114,655	203	11,583	18,223	26	18,678	31,645	96
Colorado	14,198	25,084	115	5,703	8,737	33	2,429	3,742	26
Connecticut	4,564	8,026	51	W	W	3	--	--	--
Delaware	1,875	2,552	6	W	W	2	--	--	--
Florida	W	W	3	21,400	29,540	50	--	--	--
Georgia	2,222	2,991	12	1,504	4,148	15	W	W	1
Hawaii	W	W	3	--	--	--	--	--	--
Idaho	4,431	6,051	64	W	W	3	W	W	2
Illinois	17,144	25,684	103	15,531	28,047	55	W	W	1
Indiana	8,983	13,346	74	14,747	19,368	79	W	W	2
Iowa	4,923	7,070	116	10,048	15,544	123	W	W	3
Kansas	2,190	1,824	64	5,488	5,586	46	1,158	1,532	11
Kentucky	1,048	1,182	19	1,976	2,817	7	--	--	--
Louisiana	3,134	7,444	17	7,603	15,620	40	W	W	1
Maine	3,050	4,404	44	W	W	1	--	--	--
Maryland	10,333	26,780	44	W	W	3	--	--	--
Massachusetts	14,195	22,404	114	W	W	3	--	--	--
Michigan	44,009	58,690	299	9,145	15,461	57	--	--	--
Minnesota	29,210	33,423	325	4,375	5,772	22	--	--	--
Mississippi	8,453	10,448	33	4,602	6,347	16	--	--	--
Missouri	1,999	5,930	12	1,180	2,275	10	2,182	3,211	19
Montana	2,782	3,572	45	W	W	2	--	--	--
Nebraska	669	705	30	10,453	13,854	144	384	362	9
Nevada	6,893	11,111	54	1,379	2,733	4	W	W	1
New Hampshire	5,666	7,504	47	--	--	--	--	--	--
New Jersey	9,620	24,681	48	5,857	17,543	18	--	--	--
Nex Mexico	6,597	8,417	98	W	W	2	347	1,387	6
New York	22,349	33,005	182	2,629	4,480	12	--	--	--
North Carolina	5,454	8,365	62	4,497	7,079	44	645	909	25
North Dakota	3,518	4,474	47	W	W	2	--	--	--
Ohio	17,481	30,007	186	20,247	32,153	107	381	595	6
Oklahoma	2,190	2,671	34	3,483	7,003	27	2,262	2,992	21
Oregon	9,155	14,588	82	3,602	6,390	19	884	1,073	19
Pennsylvania	8,913	22,735	76	5,982	14,291	11	659	1,679	5
Rhode Island	2,593	4,329	18	W	W	1	--	--	--
South Carolina	2,511	4,886	19	4,318	7,354	11	264	346	5
South Dakota	6,346	6,693	114	193	335	5	--	--	--
Tennessee	6,165	9,657	37	547	959	4	W	W	1
Texas	22,795	44,410	113	16,297	31,149	41	W	W	3
Utah	7,819	8,986	58	W	W	1	--	--	--
Vermont	2,076	3,127	46	--	--	--	--	--	--
Virginia	8,623	18,075	66	3,305	7,676	16	W	W	3
Washington	13,557	20,288	149	1,933	3,325	14	W	W	3
West Virginia	W	W	2	7	25	1	W	49	3
Wisconsin	23,125	27,801	251	1,587	2,319	17	--	--	--
Wyoming	4,959	7,903	48	25	W	1	W	W	4
Concealed	4,121	11,872	--	3,889	6,336	--	1,628	2,834	--
Total [2]	492,145	773,082	3,972	216,313	349,370	1,163	45,405	72,176	338

W Withheld to avoid disclosing individual company confidential data; included with "Concealed."

[1] Based on 5,686 operations which completed the 1974 supplemental form.

[2] Data may not add to totals shown because of independent rounding.

in 1974, by State, and source [1]
and thousand dollars)

Riverbed											
Navigable			Lake			Bay			Ocean		
Quantity	Value	Number of operations	Quantity	Value	Number of operations	Quantity	Value	Number of operations	Quantity	Value	Number of operations
W	W	3	--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--	W	W	1
W	W	1	--	--	--	--	--	--	--	--	--
3,133	6,043	12	--	--	--	--	--	--	--	--	--
W	W	3	--	--	--	W	W	3	--	--	--
W	W	2	--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--	--	--	--
W	W	2	--	--	--	--	--	--	--	--	--
W	W	1	--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--	--	--	--
W	W	2	--	--	--	--	--	--	--	--	--
794	1,094	8	W	W	3	--	--	--	--	--	--
452	487	1	--	--	--	--	--	--	--	--	--
178	226	5	W	W	2	--	--	--	--	--	--
1,599	2,261	8	--	--	--	--	--	--	--	--	--
4,779	7,153	10	--	--	--	--	--	--	--	--	--
100	253	1	W	W	1	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--	--	--	--
--	--	--	W	W	4	W	W	2	--	--	--
--	--	--	--	--	--	--	--	--	--	--	--
W	W	1	--	--	--	--	--	--	--	--	--
4,832	6,287	29	--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--	--	--	--
--	--	--	W	73	2	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--	--	--	--
W	W	1	W	W	1	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--	--	--	--
W	W	7	--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--	--	--	--
W	W	2	763	1,418	8	W	W	1	--	--	--
W	W	2	--	--	--	--	--	--	--	--	--
3,441	6,256	10	--	--	--	--	--	--	--	--	--
W	W	3	W	W	2	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--	--	--	--
--	--	--	125	188	1	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--	--	--	--
1,102	2,355	4	--	--	--	--	--	--	--	--	--
W	W	3	--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--	--	--	--
W	43	2	--	--	--	--	--	--	--	--	--
382	W	1	--	--	--	--	--	--	--	--	--
3,405	6,288	6	--	--	--	--	--	--	--	--	--
W	W	1	--	--	--	--	--	--	--	--	--
--	--	--	162	757	1	--	--	--	--	--	--
5,931	12,039	--	3,438	7,078	--	1,087	2,347	--	W	W	--
30,128	50,784	131	4,487	9,512	25	1,087	2,347	6	W	W	1

Table 13.—Production of sand and gravel in 1974, by State by method of mining [1]

(Thousand short tons and thousand dollars)

State	Dredge			Dragline			Shovel			Front-end loader			Other		
	Quantity	Value	Number of operations	Quantity	Value	Number of operations	Quantity	Value	Number of operations	Quantity	Value	Number of operations	Quantity	Value	Number of operations
Alabama	3,767	6,613	19	4,561	7,435	15	1,792	1,300	7	1,180	1,817	22	W	79	1
Alaska	--	--	--	1,586	1,728	9	W	W	1	22,190	18,823	85	6,163	W	30
Arizona	--	--	--	W	W	4	8,072	10,161	14	9,434	16,979	81	2,587	W	13
Arkansas	3,238	6,094	14	5,376	9,048	71	434	132	2	2,180	2,573	93	W	6,379	2
California	3,254	6,029	8	28,337	50,252	82	24,214	36,516	37	28,397	45,836	156	14,989	W	46
Colorado	1,046	1,826	9	6,381	10,146	36	66	111	1	13,630	22,873	124	1,248	W	6
Connecticut	W	W	2	907	1,334	6	640	1,137	6	3,302	5,686	40	--	--	--
Delaware	--	--	--	W	W	3	W	W	3	W	W	2	--	--	--
Florida	13,495	18,912	40	9,463	12,605	13	--	--	--	W	W	2	--	--	--
Georgia	2,827	4,643	21	W	W	2	W	W	1	169	68	4	W	7	1
Hawaii	--	--	--	--	--	--	--	--	--	W	W	3	--	--	--
Idaho	W	W	1	320	739	4	368	489	6	3,390	5,208	56	W	268	4
Illinois	12,544	17,534	41	12,140	18,583	56	577	1,591	6	8,513	12,415	65	W	686	1
Indiana	7,419	10,011	33	10,251	13,376	70	1,036	3,930	6	4,372	6,801	46	1,181	1,739	1
Iowa	4,752	7,721	40	8,949	12,105	165	W	W	7	1,574	2,559	35	W	86	3
Kansas	8,441	9,568	64	W	W	3	W	W	3	1,739	1,430	56	122	132	3
Kentucky	6,101	9,039	16	W	W	2	--	--	--	1,016	1,222	19	--	--	--
Louisiana	8,787	19,906	45	2,649	5,593	12	--	--	--	W	W	3	--	--	--
Maine	--	--	--	W	W	1	237	299	1	2,813	4,104	43	--	--	--
Maryland	434	723	2	2,417	6,984	6	442	965	4	7,683	18,878	33	257	1,001	2
Massachusetts	W	W	3	--	--	--	430	672	6	13,762	20,976	108	--	--	--
Michigan	5,781	10,689	23	24,747	33,209	140	2,364	2,520	19	21,123	29,903	177	W	1,125	3
Minnesota	1,170	1,690	5	3,698	5,843	34	3,127	2,464	8	18,789	21,505	229	6,806	W	71
Mississippi	5,008	7,061	19	3,402	4,962	11	--	--	--	4,737	5,048	20	--	--	--
Missouri	6,530	8,917	32	1,090	2,039	16	W	W	1	2,081	6,128	19	W	443	2
Montana	74	165	1	W	W	2	393	355	2	2,028	2,690	37	340	W	5
Nebraska	10,801	14,221	149	W	W	2	W	W	2	592	631	26	74	W	7
Nevada	20	88	1	W	W	2	W	W	3	5,125	9,495	42	2,168	W	11
New Hampshire	78	88	1	375	631	1	576	1,116	4	4,638	5,669	41	--	--	--
New Jersey	5,543	20,436	24	4,566	11,471	7	908	2,131	6	4,292	7,604	29	W	1,088	2
New Mexico	--	--	--	419	1,507	6	1,177	1,848	4	4,772	6,158	82	744	W	11
New York	1,272	2,089	4	1,442	2,809	13	2,232	3,524	24	19,255	28,220	150	W	845	3
North Carolina	922	1,501	17	8,148	13,267	83	103	85	4	1,476	1,602	33	W	95	3
North Dakota	--	--	--	W	W	2	110	82	1	2,336	3,390	33	1,137	W	13
Ohio	4,081	6,846	28	18,309	28,763	101	1,990	3,842	24	14,489	24,737	153	309	W	4
Oklahoma	4,545	6,044	41	1,396	1,088	11	W	W	2	1,174	1,641	27	W	3,774	2
Oregon	4,335	8,840	11	1,650	2,944	20	3,528	3,838	20	6,241	10,775	71	1,328	W	9
Pennsylvania	5,826	15,280	12	3,220	6,172	13	1,695	4,014	18	6,405	17,226	54	--	--	--
Rhode Island	--	--	--	--	--	--	W	W	2	2,538	3,951	16	W	44	1
South Carolina	1,489	1,771	11	3,295	6,136	9	W	W	1	2,333	4,793	15	--	--	--
South Dakota	W	W	3	334	583	5	W	W	2	4,248	4,294	88	1,581	W	21

Tennessee	1,900	3,279	9	1,390	1,523	11	1,399	1,406	3	3,326	6,977	18	--	--	--
Texas	7,622	13,068	14	25,953	47,116	96	2,907	5,805	14	3,109	7,981	31	649	W	5
Utah	W	W	3	W	W	3	612	W	2	5,658	6,554	45	540	W	6
Vermont	--	--	--	--	--	--	W	W	3	1,875	2,639	43	--	--	--
Virginia	415	933	5	8,358	18,146	33	733	1,316	4	1,890	4,149	42	W	1,345	3
Washington	W	W	3	4,113	5,568	20	672	1,420	6	9,930	15,273	131	681	W	8
West Virginia	3,397	6,290	6	14	30	1	W	W	1	W	W	4	--	--	--
Wisconsin	842	1,832	4	1,367	1,615	29	2,444	2,442	30	19,717	23,832	203	W	960	3
Wyoming	162	757	1	W	W	4	29	23	2	4,048	6,393	32	907	W	15
Concealed	1,932	4,008	--	3,146	5,760	--	4,595	8,848	--	2,602	10,194	--	5,538	62,660	--
Total[2]	149,847	254,012	785	213,764	351,110	1,235	69,903	101,836	328	306,706	467,650	2,967	49,343	82,704	321

W Withheld to avoid disclosing individual company confidential data; included with "Concealed."

[1] Based on 5,636 operations which completed the 1974 supplemental form.

[2] Data may not add to totals shown because of independent rounding.

Table 14.—Production of sand and gravel in 1974, by State, and land ownership (wet or dry operation on land and water) [1]

(Thousand short tons)

State	Own the land		Own mineral rights		Lease mineral rights and pay royalties		Lease private land and pay royalties		Lease public land and pay royalties	
	Quantity	Number of operations	Quantity	Number of operations	Quantity	Number of operations	Quantity	Number of operations	Quantity	Number of operations
Alabama	711	7	--	--	3,319	10	7,146	47	W	1
Alaska	5,824	33	W	1	447	6	948	3	22,655	82
Arizona	7,179	34	55	2	3,540	20	5,162	37	4,514	18
Arkansas	2,947	18	40	2	2,348	27	4,579	126	1,855	9
California	45,209	104	W	3	13,606	42	35,073	158	3,316	21
Colorado	11,250	76	96	1	2,561	14	7,249	77	1,215	8
Connecticut	3,528	43	W	2	W	3	729	5	344	1
Delaware	W	3	--	--	--	--	W	5	--	--
Florida	12,093	27	--	--	1,378	7	10,093	21	--	--
Georgia	2,842	16	W	1	W	2	783	10	--	--
Hawaii	4	1	--	--	--	--	329	1	W	1
Idaho	3,000	41	72	1	W	3	1,492	22	278	4
Illinois	21,245	75	W	1	3,170	24	9,543	68	W	2
Indiana	13,046	83	W	3	2,537	13	8,411	55	W	1
Iowa	5,818	68	W	3	1,918	37	7,521	129	274	13
Kansas	4,021	34	--	--	1,887	26	3,915	64	612	5
Kentucky	1,907	6	--	--	W	2	3,801	23	809	6
Louisiana	2,314	15	--	--	525	4	8,602	40	17	1
Maine	1,784	31	--	--	--	--	1,266	13	W	1
Maryland	6,253	30	W	1	1,092	6	3,707	10	--	--
Massachusetts	10,379	82	1,175	6	1,282	11	1,692	17	3	1
Michigan	29,224	170	W	3	5,207	29	18,432	154	1,309	6
Minnesota	16,456	163	W	1	4,430	54	12,015	127	W	3
Mississippi	4,079	13	--	--	970	9	7,862	27	235	1
Missouri	3,892	22	--	--	383	5	5,085	37	832	6
Montana	2,297	31	--	--	177	5	409	10	34	1
Nebraska	4,734	46	W	1	1,680	40	5,035	96	W	2
Nevada	4,868	23	--	--	1,017	7	1,894	18	522	11
New Hampshire	4,101	38	208	2	945	4	W	3	--	--
New Jersey	12,259	53	W	2	W	3	2,143	9	W	1
New Mexico	3,120	26	77	4	W	3	2,960	54	849	16
New York	16,034	127	W	2	1,979	17	4,713	48	--	--
North Carolina	4,267	42	941	10	339	7	5,147	73	W	6
North Dakota	1,573	18	--	--	633	7	1,300	23	W	1
Ohio	25,352	172	603	6	4,698	50	7,933	79	592	5
Oklahoma	2,795	20	--	--	1,724	14	3,428	49	180	1
Oregon	8,446	68	W	1	2,108	16	3,168	87	3,343	9
Pennsylvania	11,192	57	W	1	1,030	10	2,849	21	1,910	8
Rhode Island	1,031	10	W	2	--	--	397	5	W	2
South Carolina	2,201	12	W	1	991	8	3.688	15	--	--

South Dakota	2,537	51	185	5	792	21	3,024	42	--	--
Tennessee	1,055	12	W	2	2,093	12	3,781	17	W	3
Texas	8,865	37	W	2	6,335	23	24,626	95	W	3
Utah	6,460	37	67	1	137	4	1,414	16	W	1
Vermont	1,650	24	--	--	26	1	400	21	--	--
Virginia	3,824	36	W	1	3,348	13	4,803	37	--	--
Washington	10,800	114	W	1	1,280	10	3,065	38	650	5
West Virginia	W	3	--	--	W	1	W	2	1,926	6
Wisconsin	12,160	111	W	1	4,175	83	7,246	70	185	4
Wyoming	2,969	17	W	1	421	8	1,590	20	245	8
Concealed	2,169	--	9,468	--	2,521	--	3,606	--	3,006	--
Total[2]	371,763	2,380	12,988	77	89,044	721	264,057	2,174	51,711	284

W Withheld to avoid disclosing individual company confidential data included with "Concealed."

[1] Based on 5,636 operations which completed the 1974 supplemental form.

[2] Data may not add to totals shown because of independent rounding.

Table 15.—Estimated capital investment in 1974, in the producing sand and gravel industry by State, and source [1]

(Thousand dollars)

State	Dry pit on land		Wet pit on land		Riverbed				Lake		Bay		Ocean	
					Not navigable		Navigable							
	Value	Number of operations	Value	Number of operations	Value	Number of operations	Value	Number of operations	Value	Number of operations	Value	Number of operations	Value	Number of operations
Alabama	7,068	36	3,568	20	305	4	2,162	3	--	--	--	--	--	--
Alaska	26,831	90	10,580	31	100	2	--	--	--	--	--	--	50	1
Arizona	17,466	64	364	2	27,685	45	250	1	--	--	--	--	--	--
Arkansas	41,372	158	91,665	11	1,921	11	5,825	12	--	--	--	--	--	--
California	100,037	187	15,836	39	27,317	96	880	3	--	--	700	3	--	--
Colorado	23,568	114	8,261	33	6,789	26	125	2	--	--	--	--	--	--
Connecticut	7,115	50	430	3	--	--	--	--	--	--	--	--	--	--
Delaware	2,700	6	250	2	--	--	--	--	--	--	--	--	--	--
Florida	1,176	3	29,024	50	--	--	542	2	--	--	--	--	--	--
Georgia	2,727	12	23,573	15	20	1	50	1	--	--	--	--	--	--
Hawaii	849	3	--	--	--	--	--	--	--	--	--	--	--	--
Idaho	10,394	63	397	5	375	2	280	2	--	--	--	--	--	--
Illinois	24,359	101	19,335	62	250	1	1,106	8	226	3	--	--	--	--
Indiana	11,189	74	24,545	79	200	2	400	1	--	--	--	--	--	--
Iowa	9,099	115	18,466	123	369	3	995	5	133	2	--	--	--	--
Kansas	4,829	61	150,778	45	1,659	11	1,203	8	--	--	--	--	--	--
Kentucky	2,171	20	3,669	7	--	--	11,562	10	--	--	--	--	--	--
Louisiana	4,255	17	14,955	40	50	1	50	1	1,200	1	--	--	--	--
Maine	6,991	43	50	1	--	--	--	--	--	--	--	--	--	--
Maryland	19,444	43	3,759	3	--	--	--	--	--	--	--	--	--	--
Massachusetts	31,223	110	1,435	6	--	--	--	--	--	--	--	--	--	--
Michigan	70,284	298	14,278	57	--	--	--	--	1,225	4	775	2	--	--
Minnesota	66,684	324	4,778	24	--	--	--	--	--	--	--	--	--	--
Mississippi	9,865	32	4,935	16	--	--	50	1	--	--	--	--	--	--
Missouri	2,414	12	1,654	10	3,301	19	7,791	29	--	--	--	--	--	--
Montana	5,658	44	495	3	--	--	--	--	--	--	--	--	--	--
Nebraska	7,477	31	45,013	140	420	9	--	--	90	2	--	--	--	--
Nevada	13,596	53	952	5	51	1	--	--	--	--	--	--	--	--
New Hampshire	9,528	46	--	--	--	--	--	--	--	--	--	--	--	--
New Jersey	20,611	45	12,208	20	--	--	200	1	50	1	--	--	--	--
New Mexico	17,365	92	678	7	746	6	--	--	--	--	--	--	--	--
New York	36,939	179	4,981	15	--	--	--	--	--	--	--	--	--	--
North Carolina	9,171	61	6,793	44	1,358	25	350	7	--	--	--	--	--	--
North Dakota	56,599	46	114	3	--	--	--	--	--	--	--	--	--	--
Ohio	29,198	183	27,830	113	563	6	192	2	1,238	8	500	1	--	--
Oklahoma	3,323	34	4,430	27	2,086	21	250	2	--	--	--	--	--	--
Oregon	17,151	79	10,364	22	1,792	18	6,727	10	--	--	--	--	--	--
Pennsylvania	28,423	75	128,996	11	168,527	5	2,250	3	567	2	--	--	--	--
'e Island	4,252	18	240	1	--	--	--	--	--	--	--	--	--	--

South Carolina	8,998	19	5,040	11	270	5	--	--	200	1	--	--	--	--
South Dakota	25,640	113	525	5		--	--	--	--	--	--	--	--	--
Tennessee	9,479	34	1,350	5	300	1	795	4	--	--	--	--	--	--
Texas	28,843	110	20,166	46	205	3	1,500	3	--	--	--	--	--	--
Utah	12,048	57	592	6	--	--	--	--	--	--	--	--	--	--
Vermont	6,040	45	105	1	--	--	--	--	--	--	--	--	--	--
Virginia	16,580	63	3,347	19	130	3	45	2	--	--	--	--	--	--
Washington	27,689	147	3,056	19	180	3	225	1	--	--	--	--	--	--
West Virginia	9,500	2	70	1	116	3	6,890	6	--	--	--	--	--	--
Wisconsin	34,540	250	3,426	18	--	--	12	1	--	--	--	--	--	--
Wyoming	8,118	47	68	1	1,059	4	--	--	478	1	--	--	--	--
Total	950,876	3,909	727,419	1,227	248,144	337	52,707	131	5,407	25	1,975	6	50	1

[1] Based on 5,636 operations which completed the 1974 supplemental form.

Table 16.—Estimated sand and gravel reserves at producing operations in 1974, by State, and source[1]
(Thousand short tons)

State	Dry pit on land		Wet pit on land		Riverbed				Lake		Bay	
					Not navigable		Navigable					
	Quantity	Number of operations	Quantity	Number of operations	Quantity	Number of operations	Quantity	Number of operations	Quantity	Number of operations	Quantity	Number of operations
Alabama	38,372	14	169,438	10	1,130	2	--	--	--	--	--	--
Alaska	11,396	11	4,398	5	--	--	--	--	--	--	--	--
Arizona	75,350	37	21,818	2	212,287	33	1,300	1	--	--	--	--
Arkansas	72,865	117	1,851	5	17,653	6	3,905	2	--	--	--	--
California	1,072,068	137	120,209	20	195,530	56	14,422	2	--	--	2,378	1
Colorado	70,434	60	64,915	26	8,550	9	--	--	--	--	--	--
Connecticut	39,042	37	1,721	1	--	--	--	--	--	--	--	--
Delaware	1,157	2	--	--	--	--	--	--	--	--	--	--
Florida	--	--	239,191	26	--	--	--	--	--	--	--	--
Georgia	111,820	6	17,434	9	--	--	--	--	--	--	--	--
Hawaii	16,717	2	--	--	--	--	--	--	--	--	--	--
Idaho	70,132	42	1,768	2	9	1	211	1	--	--	--	--
Illinois	174,330	64	153,186	33	--	--	--	--	--	--	--	--
Indiana	125,947	50	160,384	46	--	--	--	--	--	--	--	--
Iowa	31,815	85	76,876	83	--	--	294	2	--	--	--	--
Kansas	13,673	17	62,193	19	424	2	4,010	2	--	--	--	--
Kentucky	16,518	7	20,139	4	--	--	45,663	4	--	--	--	--
Louisiana	12,281	9	70,253	26	--	--	--	--	--	--	--	--
Maine	34,319	29	--	--	--	--	--	--	--	--	--	--
Maryland	76,692	32	6,884	2	--	--	--	--	--	--	--	--
Massachusetts	110,441	80	103	1	--	--	--	--	--	--	--	--
Michigan	423,570	174	95,687	37	--	--	--	--	9,398	1	--	--
Minnesota	233,615	196	81,826	16	--	--	--	--	--	--	--	--
Mississippi	76,059	20	909	3	--	--	--	--	--	--	--	--
Missouri	15,825	6	1,136	3	6,230	4	50,208	5	--	--	--	--
Montana	5,450	16	1,220	1	--	--	--	--	--	--	--	--
Nebraska	3,853	16	69,413	60	971	7	--	--	120	1	--	--
Nevada	82,420	26	7,798	3	--	--	--	--	--	--	--	--
New Hampshire	31,650	23	--	--	--	--	--	--	--	--	--	--
New Jersey	119,205	36	166,307	6	--	--	--	--	1,178	1	--	--
New Mexico	40,615	46	2,187	2	2,235	4	--	--	--	--	--	--
New York	289,335	104	38,173	6	--	--	--	--	--	--	--	--
North Carolina	61,682	10	28,058	24	757	5	688	4	--	--	--	--
North Dakota	24,365	24	1,237	2	--	--	--	--	--	--	--	--
Ohio	202,846	111	341,616	82	879	4	--	--	238	1	--	--
Oklahoma	3,081	9	7,702	5	4,593	5	--	--	--	--	--	--
Oregon	150,128	51	57,209	13	18,238	6	12,534	3	--	--	--	--
Pennsylvania	117,757	70	144,858	8	5,039	2	--	--	--	--	--	--
Rhode Island	23,184	11	257	1	--	--	--	--	--	--	--	--
South Carolina	21,130	6	35,100	10	1,755	2	--	--	--	--	--	--
South Dakota	46,286	57	2,589	2	--	--	--	--	--	--	--	--
Tennessee	258,098	23	785	2	--	--	265	1	--	--	--	--

Texas	196,648	75	123,935	31	240	1	727	1	--	--	--	--
Utah	141,503	36	4,215	1		--	--	--	--	--	--	--
Vermont	25,717	20				--	--	--	--	--	--	--
Virginia	78,830	28	22,348	9	900	1	166	1	--	--	--	--
Washington	174,910	99	23,300	12	9	1	--	--	--	--	--	--
West Virginia	28,783	2			59	1	31,070	2	--	--	--	--
Wisconsin	246,017	127	10,993	11			--	--	--	--	--	--
Wyoming	14,601	25	--		142	1	--	--	3,234	1	--	--
Total[3]	5,312,527	2,285	2,461,567	670	477,630	158	165,462	31	14,167	5	2,378	1

[1] Based on 3,145 operations which completed the 1974 supplemental form.

[3] Data may not add to totals shown because of independent rounding.

Silicon

By E. Shekarchi [1]

The strong demand and tight market for silicon metal and ferrosilicon that existed in 1973 and the first 9 months of 1974 finally eased during the fourth quarter of 1974. Major producers were predicting not only the availability of silicon metal for 1975, but also a possible price reduction. Many silicon metal producers allocated their entire 1974 production to established customers with a price-in-effect-at-time-of-shipment clause. Market conditions, combined with rising production costs, especially for coal and coke, forced price increases several times during the first 9 months of 1974.

With plant expansion and/or modernization completed, domestic production of ferrosilicon and silicon metal showed an increase for the fourth quarter. Overseas production capacity for silicon metal and ferrosilicon was also increased as several new plants came into production during the year. By yearend, domestic stocks were 30.8% greater than at the close of 1973, reflecting increased world production and easing of the tight market.

Tyco Laboratories, Inc., after 2 years of research, developed techniques for producing a silicon ribbon, the basic material for the manufacture of solar cells.

DOMESTIC PRODUCTION

On a gross weight basis, net production of ferrosilicon and silicon metals and alloys increased only 1%, whereas shipments decreased 15.2% in 1974 compared with 1973 figures. Yearend stocks showed an increase of 30.8% in 1974 compared with those of 1973, reflecting decreasing demand by steelmakers for specialized raw materials, the growth of electric furnace capacity, and improved smelting technology.

The production of nominal 50% ferrosilicon decreased 7.8%, whereas ferrosilicon containing 56% to 70% silicon increased 8.6% during the year. The production of ferrosilicon with 71% to 80% silicon content increased 23.6%, but production of 81% to 95% ferrosilicon decreased to only 100 tons in 1974 from 3,785 tons in 1973. Production of silicon metal, consumed mostly by the chemical and aluminum industries, rose 5.2% compared with 1973 output. Ferrosilicon and silicon metals and alloys were produced at 24 plants by 14 companies, as shown in table 2.

Tyco Laboratories, Inc., Waltham, Mass., agreed to form a joint company with Mobil Oil Corp. to develop and market silicon ribbon, the basic material used in solar cells. After 2 years of research, Tyco Laboratories, a developer of diversified electronics and consumer products, was able to show that silicon ribbon could be produced economically. Under the agreement, Mobil Oil was to provide up to $30 million for the development and possible marketing of silicon ribbon. Mobil Oil Corp. was to own 80% of the newly formed company, and Tyco Laboratories, Inc., 20%.

Officials of Ohio Ferro-Alloys Corp. announced in July that it would build a 46-megawatt-ampere closed ferrosilicon furnace in Philo, Ohio. The company expected the plant to go into production by April 1975. Projected capacity of the plant was given as 40,000 tons of ferrosilicon annually.

In August, representatives of Dow Corning Corp. reported plans to build a silicon production plant in Carrollton, Ky. The plant was to produce semiconductor-grade silicon and was expected to cost $46 million. The expected completion date was given as July 1977.

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[1] Physical scientist, Division of Ferrous Metals.

In January, the management of National Metallurgical Corp. announced plans to expand the production capacity of its silicon plant at Springfield, Oreg., from 4,500 to 13,000 tons annually. The expansion program was to cost about $5.5 million, including $1.5 million for pollution control equipment.

Foote Mineral Company's modernization program at Graham, W. Va., continued through 1974. Included in the modernization plan was the addition of a 20-megawatt furnace equipped with an air pollution control device. The plant was scheduled to resume full operation by mid-1975.

Officials of Union Carbide Corp. reported expenditures of $30 million to expand the production capacity of its plants at Alloy, W. Va., and Ashtabula, Ohio. The Alloy plant was to increase its silicon metal production capacity by 15,000 tons; the Ashtabula plant was to add 75,000 tons to its ferrosilicon production by yearend.

Table 1.—Production, shipments, and stocks of silvery pig iron, ferrosilicon, and silicon metal in 1974
(Short tons, gross weight)

Alloy	Silicon content percent	Producers' stocks as of Dec. 31, 1973 r	Production	Shipments	Producers' stocks as of Dec. 31, 1974
Silvery pig iron	5–24	W	W	W	W
Ferrosilicon (including briquets)	25–55	17,484	470,016	368,266	20,204
Do	56–70	2,429	63,351	61,163	3,581
Do	71–80	9,876	158,621	142,155	9,419
Do	81–95	33	100	119	--
Silicon metal (excluding semiconductor grades)	96–99	4,764	140,502	119,154	8,381
Miscellaneous silicon alloys (excluding silicomanganese)	--	4,902	88,096	79,221	7,543
Other silicon alloys and products	--	1,950	14,228	14,651	5,092

r Revised. W Withheld to avoid disclosing individual company confidential data.

Table 2.—Producers of silicon alloys and/or silicon metal in the United States in 1974

Producers	Plant location	Product
Airco, Inc., Airco Alloys and Carbide Div	Calvert City, Ky	FeSi.
Do	Charleston, S.C	Do.
Do	Mobile, Ala	Do.
Do	Niagara Falls, N. Y	Do.
Alabama Alloy Co. Inc	Woodward, Ala	Do.
Alabama Metallurgical Corp	Selma, Ala	FeSi, Si.
Foote Mineral Company	Graham, W. Va	Do.
Do	Keokuk, Iowa	Silvery pig iron.
Hanna Mining Co	Wenatchee, Wash	FeSi, Si.
Hanna Nickel Smelting Co	Riddle, Oreg	FeSi.
Interlake Steel Corp	Beverly, Ohio	FeSi, Si.
National Metallurgical Corp	Springfield, Oreg	Si.
Ohio Ferro-Alloys Corp	Brilliant, Ohio	FeSi, Si.
Do	Philo, Ohio	Do.
Do	Powhatan Point, Ohio	Do.
Reynolds Metals Co	Sheffield, Ala	Si.
Roane Electric Furnace Co. Inc.	Rockwood, Tenn	FeSi.
Tennessee Alloys Corp	Bridgeport, Ala	Do.
Tennessee Metallurgical Corp	Kimball, Tenn	Do.
Union Carbide Corp. Ferralloys Div	Alloy, W. Va	FeSi, Si.
Do	Ashtabula, Ohio	FeSi.
Do	Marietta, Ohio	Do.
Do	Portland, Oreg	Do.
Do	Sheffield, Ala	Do.

CONSUMPTION AND USES

Consumption of silvery pig iron, primarily by iron foundries, decreased 28.8% in 1974 compared with 1973 data. Ferrosilicon, used mostly for deoxidizing steel and producing silicon alloy steel and cast iron, also showed decreases in consumption. The greatest decrease, 32.8%, was in ferrosilicon with a silicon content of 56% to 70%; whereas decreases of 18.9% and 19.5% were reported for ferrosilicon with silicon contents of 25% to 55% and 81% to 95%, respectively. Consumption of ferrosilicon with a silicon content of 71% to 80% increased 22.8% over that consumed in 1973. In Europe and Japan, this grade of ferrosilicon also showed the highest consumption rate, probably reflecting a trend which was observed in the U.S. steelmaking industry in 1974.

Silicon metal consumption decreased 2.3% in 1974 compared with that of 1973. The decrease essentially was due to a reduction of aluminum output in the latter part of 1974. High-purity silicon consumption remained strong during the year. Producers and consumers of the polycrystalline and high-purity silicon were Texas Instruments, Incorporated, Motorola, Inc., Fairchild Camera & Instruments Corp., and Dow Corning Corp. All of these companies operated at full capacity during the year and anticipated new and expanded production capacities by 1975.

Silicone rubber compounds were found to be stable, durable, flexible, and unaffected by variant temperature. The main use for silicone resins was still electrical insulation, especially where elevated temperatures were expected, such as in roters, starters, and heavy-duty electrical motors. Silicone-based paints were used extensively in 1974.

Table 3.—Consumption, by major end use and stocks of silicon alloys and metal in the United States in 1974

(Short tons)

	Silvery pig iron	Ferrosilicon [1]				Silicon metal	Miscellaneous silicon alloys [2]
Silicon content ---- percent --	5–24	25–55	56–70	71–80	81–95	96–99	
Steel:							
Carbon	7,514	99,802	3,130	58,751	548	1,001	17,098
Stainless and heat-resisting	([3])	16,585	727	18,928	186	82	659
Full alloy	2,196	33,949	1,454	16,485	723	1,452	1,642
High-strength, low-alloy	1,197	6,652	([4])	3,224	([4])	([4])	1,101
Electric	--	335	([4])	28,282	([4])	822	--
Tool	--	1,848	([3])	1,497	([3])	([3])	68
Cast irons	189,789	196,109	5,316	38,784	4,598	41	89,857
Superalloys	9	187	10	87	183	89	20
Alloys (excluding alloy steels and superalloys)	133	3,571	--	225	11,356	58,087	8,321
Miscellaneous and unspecified	3,310	4,705	62	891	130	41,669	2,485
Total	204,148	363,738	10,699	167,154	17,724	103,248	121,196
Consumers stocks, Dec. 31, 1974	77,382	47,567	1,648	29,701	5,127	12,021	10,629

[1] Includes briquets.
[2] Includes magnesium-ferrosilicon and other silicon alloys.
[3] Included with "Miscellaneous and unspecified."
[4] Included with "Full Alloy Steel."

PRICES

After the Cost of Living Council decontrolled all ferroalloy prices in March 1974, ferrosilicon and silicon metal prices increased several times owing to higher costs of materials and energy. The f.o.b. price of 50% ferrosilicon increased from 18.5 cents per pound in 1973 to about 33 cents per pound contained silicon, bulk, carload lots, in 1974. Metallurgical-grade silicon, 98% minimum silicon, 0.35% maximum iron, increased from 28.4 cents in 1973 to 46.7 cents per pound contained silicon in 1974. Amorphous silicon in 50-pound paper bags, 200 mesh, 90% to 95% silicon, was increased to $28 per ton in 1974 from $27 in 1973.

The price increases for ferrosilicon and silicon metal in the first 9 months of 1974 were attributed to insufficient growth of production capacity during the previous 5 years, coupled with higher costs of energy and materials. However, during the final quarter of 1974, production from expanded old facilities and new installations increased supplies sufficiently to satisfy the demand. At yearend, producers were predicting possible price reductions in 1975.

FOREIGN TRADE

Exports of ferrosilicon and silicon metal decreased 58.9% in quantity and about 17.6% in value. Major recipients were Canada, 4,401 tons; Bolivia, 797 tons; Mexico, 416 tons; and The Republic of South Africa, 223 tons. Twenty countries received shipments of ferrosilicon and silicon metal ranging from 1 to 100 tons.

The trade imbalance in ferrosilicon evident in the United States in 1973 continued in 1974. Imports of ferrosilicon for consumption increased 41% in gross weight and 211% in value over those of 1973. Silicon metal imports for consumption decreased 31% in quantity but increased 40% in value as a result of inflated prices. Major increases in value were in both the not-over-99.7%-silicon-metal and the over-99.7%-silicon-metal categories. Total value of imports of ferrosilicon and silicon metal amounted to $83 million in 1974 compared with $33 million in 1973.

Table 4.—U.S. exports of ferrosilicon

Year	Quantity (short tons)	Value (thousands)
1972	7,367	$2,196
1973	15,984	4,051
1974	6,575	3,338

Table 5.—U.S. imports for consumption of ferrosilicon and silicon metal, by grade and country

Grade and country	1972			1973			1974		
	Quantity (short tons)		Value (thousands)	Quantity (short tons)		Value (thousands)	Quantity (short tons)		Value (thousands)
	Gross weight	Silicon content		Gross weight	Silicon content		Gross weight	Silicon content	
Ferrosilicon:									
Over 8% but not over 60% silicon:									
Belgium-Luxembourg	--	--	--	--	--	--	19	9	$15
Canada	6,579	1,043	$419	[r] 16,005	[r] 3,474	[r] $1,153	20,350	4,205	1,786
Denmark	118	51	37	1,051	467	349	661	295	208
France	2,553	1,245	936	[r] 2,820	[r] 1,522	[r] 1,104	4,278	2,367	2,360
Germany, West	552	305	226	[r] 282	[r] 145	[r] 167	332	170	245
Italy	--	--	--	--	--	--	190	87	72
Japan	2,466	1,174	736	[r] 1,379	[r] 658	[r] 469	875	399	640
Mexico	--	--	--	--	--	--	948	454	336
Norway	2,205	980	684	1,485	659	471	907	404	546
South Africa, Republic of	--	--	--	1,299	492	104	--	--	--
Spain	57	26	16	--	--	--	78	39	19
Sweden	--	--	--	--	--	--	99	44	37
United Kingdom	--	--	--	--	--	--	25	7	5
Total	14,525	4,824	3,054	[r] 24,321	[r] 7,417	[r] 3,817	28,762	8,480	6,269
Over 60% but not over 80% silicon:									
Belgium-Luxembourg	55	37	23	36	22	15	217	170	177
Brazil	--	--	--	350	263	71	3,254	2,483	2,194
Canada	949	715	240	[r] 2,971	[r] 2,240	[r] 757	4,977	3,707	1,937
Egypt	--	--	--	--	--	--	716	534	856
France	4,538	2,806	1,791	[r] 8,025	[r] 4,915	[r] 3,368	10,278	6,468	6,327
Germany, West	56	35	21	101	67	56	1,515	1,097	678
Greece	--	--	--	2,778	2,110	536	--	--	--
India	--	--	--	--	--	--	2,300	1,710	499
Italy	--	--	--	--	--	--	320	244	182
Japan	--	--	--	2	1	1	7,043	5,389	7,436
Korea, Republic of	--	--	--	--	--	--	568	448	355
Mexico	--	--	--	--	--	--	405	304	323
Netherlands	2,894	2,205	433	854	635	156	520	418	169
Norway	9,159	6,935	1,549	37,818	28,565	6,884	26,966	20,297	9,399
Poland	--	--	--	--	--	--	255	196	112
Portugal	--	--	--	--	--	--	1,012	772	771
Sierre Leone	--	--	--	--	--	--	22	16	30

See footnotes at end of table.

Table 5.—U.S. imports for consumption of ferrosilicon and silicon metal, by grade and country—Continued

Grade and country	1972			1973			1974		
	Quantity (short tons)		Value (thousands)	Quantity (short tons)		Value (thousands)	Quantity (short tons)		Value (thousands)
	Gross weight	Silicon content		Gross weight	Silicon content		Gross weight	Silicon content	
Ferrosilicon—Continued:									
Over 60% but not over 80% silicon:									
South Africa, Republic of	157	120	$34	614	470	$152	3,394	2,558	$1,950
Spain	--	--	--	771	578	127	9,742	7,359	6,612
Sweden	4,901	3,632	1,256	15,622	11,599	3,953	23,107	17,315	9,314
Switzerland	--	--	--	--	--	--	110	87	101
Taiwan	--	--	--	--	--	--	3,149	2,342	2,532
Thailand	--	--	--	--	--	--	160	121	98
Turkey	2,211	1,697	367	--	--	--	--	--	--
U.S.S.R	--	--	--	110	87	60	677	527	706
United Kingdom	--	--	--	--	--	--	236	178	123
Yugoslavia	--	--	--	5,566	4,264	1,237	11,613	8,906	6,424
Total	24,920	18,182	5,714	r 75,613	r 55,816	r 17,373	112,556	83,641	59,305
Over 80% but not over 90% silicon:									
Canada	--	--	--	369	319	39	101	86	43
South Africa, Republic of	--	--	--	27	24	8	--	--	--
Switzerland	--	--	--	--	--	--	110	89	61
United Kingdom	--	--	--	--	--	--	58	52	51
Yugoslavia	--	--	--	--	--	--	20	16	10
Total	--	--	--	396	343	47	289	243	165
Over 90% silicon content:									
Belgium-Luxembourg	--	--	--	--	--	--	274	256	281
France	40	38	12	--	--	--	--	--	--
Japan[1]	--	--	--	112	110	60	--	--	--
Netherlands	--	--	--	--	--	--	109	100	74
Norway	115	110	35	--	--	--	--	--	--
Poland	--	--	--	--	--	--	108	102	74
Sweden	--	--	--	39	38	19	--	--	--
Switzerland	--	--	--	--	--	--	17	15	21
Yugoslavia	--	--	--	--	--	--	116	114	161
Total	155	148	47	r 151	r 148	r 79	624	587	611
Grand total	39,600	23,154	8,815	r 100,481	r 63,724	r 21,316	142,231	92,951	66,350
Silicon metal:									
Not over 99.7% silicon:									
Belgium-Luxembourg	--	--	--	92	91	44	152	149	93
Canada	790	780	385	259	256	112	3	2	2
France	121	120	46	1,125	1,099	499	304	301	133
Germany, West	(2)	(2)	(2)	18	17	11	--	--	--
Italy	1,681	1,657	584	--	--	--	--	--	--
Japan	--	--	--	248	244	107	60	57	99
Netherlands	--	--	--	816	808	440	203	185	356
Norway	1,306	1,281	413	2,784	2,747	1,156	2,499	2,464	1,939
Portugal	--	--	--	--	--	--	33	32	14
Spain	--	--	--	55	54	37	--	--	--
Sweden	--	--	--	20	19	9	--	--	--
Switzerland	--	--	--	384	379	207	--	--	--
Taiwan	--	--	--	--	--	--	313	311	480
United Kingdom	276	272	97	755	748	398	66	65	77
Yugoslavia	61	55	18	r 1,656	r 1,396	r 617	1,875	1,856	2,616
Total	4,235	4,165	1,543	r 8,212	r 7,858	r 3,637	5,508	5,422	5,809
Over 99.7% silicon:									
Belgium-Luxembourg	(2)	(2)	33	1	1	142	1	1	96
Canada	1	1	2	21	21	15	1	1	4
Denmark	(2)	(2)	73	1	1	79	2	2	347
France	1	1	35	108	108	125	60	60	150
Germany, West	53	53	3,318	81	81	7,012	87	87	6,639
Italy	--	--	--	--	--	--	3	3	263

See footnotes at end of table.

Table 5.—U.S. imports for consumption of ferrosilicon and silicon metal, by grade and country—Continued

Grade and country	1972			1973			1974		
	Quantity (short tons)		Value (thousands)	Quantity (short tons)		Value (thousands)	Quantity (short tons)		Value (thousands)
	Gross weight	Silicon content		Gross weight	Silicon content		Gross weight	Silicon content	
Silicon metal—Continued:									
Over 99.7% silicon:									
Japan	5	5	$450	12	12	r $819	57	57	$2,982
Netherlands	--	--	--	220	220	115	--	--	--
Norway	--	--	--	--	--	--	111	111	87
Portugal	--	--	--	--	--	--	43	43	48
U.S.S.R	--	--	--	--	--	--	(2)	(2)	130
United Kingdom	(2)	(2)	7	(2)	(2)	11	--	--	--
Yugoslavia	--	--	--	--	--	--	127	127	145
Total	60	60	3,923	444	444	r 8,318	492	492	10,891
Grand total	4,295	4,225	5,466	r 8,656	r 8,302	r 11,955	6,000	5,914	16,700

r Revised.

[1] Data differ from that shown in previous edition owing to different source.

[2] Less than ½ unit.

WORLD REVIEW

Canada.—In July 1974, officials of Suddeutsche Kalkstickstoff-Werks, A. Co. (SKW), of Trostberg, West Germany, announced plans to build a $40 million silicon metal and ferrosilicon plant in Becancour, Quebec, Canada. According to SKW, jointly owned by Hoechst Company and a German state firm, an annual production of 25,000 tons each of silicon metal and ferrosilicon was scheduled to begin in 1976.

India.—During 1974, production of ferrosilicon and silicon metal was about 28,000 tons, 20% below 1973 production. The decline was attributed to energy shortages and a decrease in the production of iron and steel and aluminum. Total ferrosilicon and silicon metal consumption by India's steel and aluminum industries was estimated at 25,000 tons in 1974, all of which was produced domestically. Exports of ferrosilicon in 1974 were about 3,000 tons—2,300 tons to the United States and the remainder to Singapore.

Japan.—Production of ferrosilicon and silicon metal in 1974 was 350,000 tons, 10% greater than that of 1973. To overcome possible ferrosilicon shortages in the future, producers were expanding present facilities or venturing into mergers domestically and overseas.

The management of Nippon Refining and Concentrating Co. was planning to add a 16,000-ton-per-year ferrosilicon plant at Kohma. The power for this plant was to be supplied from Nippon's Matsukawa powerplant at a reduced price. The completion date of the plant was given as early 1976.

The merger of Nippon Refining Co. with Tohuku Refining Co. was to be finalized in April of 1975. Tohuku operates a plant with a 22,000-ton-per-year capacity.

In October 1974, it was reported that Japan Metals and Chemicals Co. (JMC) had begun construction on the first of two new electric furnaces at Matsukawa. The furnace, using power from the JMC geothermal plant, was to have a capacity of 34,000 tons per year of ferrosilicon, and was expected to go onstream by 1976. Construction of the second furnace was to begin at that time.

A joint project between Nippon Denko Co., C. Itoh and the Philippine Laurel Co. was given confirmation regarding power availability for their proposed 23,000-ton ferrosilicon production facility in the Philippines. Completion of this project was expected sometime in 1977.

Portugal.—In September 1974, Companhia Portuguesa de Fornos Electricos (CPFE), was authorized by the Portuguese Government to proceed with its plan to install a second 25-megawatt-ampere ferrosilicon furnace at Canas. CPFE's first 25-megawatt-ampere furnace, under construction in 1974, was scheduled to produce up to 12,000 tons of silicon metal annually starting April 1975.

South Africa, Republic of.—African Oxygen Ltd., through its subsidiaryl Dawson and Dobson, teamed with two overseas companies—Aluminum Co. of Canada, Ltd. (ALCAN) and Foote Mineral Company of the United States—to form a silicon metal venture called Silicon Smelter (Pty.), Ltd. (SSPL), in 1973. The three partners shared equally in the venture. Construction of the new smelter plant remained on schedule, and by December 1974 the first of three giant smelters was commissioned, making SSPL the first silicon metal producer in Africa. The company, when in full operation at the end of 1975, was expected to produce 32,000 tons of silicon metal annually. The 90,000 tons of silica feed for the smelter was to come from the Whitkop mine. Recoverable reserves from this mine were estimated at 4 million tons of pure quartz, enough to sustain the operation for the next 25 years. The cost of constructing the smelting plant was about $25 million.

Yugoslavia.—The Yugoslavian Economic Organization's (YEO) Jugohrom Company at Jegunovce in southern Yugoslavia continued construction of its ferrosilicon plant. Projected capacity of the plant was increased to 50,000 tons of ferrosilicon from the previously reported 30,000 tons. The completion date was given as the latter part of 1976. Most of the production was to be for export to markets in Europe and Japan.

Total production of ferrosilicon and silicon metal and alloys by Yugoslavia was estimated at 70,000 tons in 1974.

Silver

By Thomas G. Clarke[1]

Domestic mine production of silver decreased 10% from that of 1973 to 33.8 million troy ounces. The decrease, mainly in byproduct metal, was attributed partly to a copper mine strike in Arizona, depressed demand for copper metal, and producer cutbacks in the copper industry. Imports exceeded exports by 115 million troy ounces compared with 119.5 million troy ounces in 1973. The price of silver continued its sharp, upward trend from the close of 1973. On January 2, 1974, the average price was 334.5 cents per ounce, but fell to 327 cents per ounce on January 4, the low of the year. On February 26, the historic high price of 670 cents per ounce was reached during the day, but closed off the peak price by the end of daily trading. Average monthly prices remained in the low $5 range through May, then fell into and remained in the $4 to $5 range for the rest of the year. On December 31, the price was 437 cents per ounce. The average price in 1974 was 470.798 cents per ounce.

Domestic consumption by industry and the arts was 177 million ounces, down 10% from the record high of 196.4 million ounces in 1973. The end-use categories mirrors, batteries, bearings, and catalysts showed significant increases over 1973. Table 9 contains a new reporting category, coins, medallions, and commemorative objects, with appropriate revisions in other data for the years 1972–74. These data were formerly reported in the sterling ware and miscellaneous categories of the end-use table. By the end of 1974, consumption of silver in the coins, medallions, and commemorative objects category had increased to 22.3 million ounces, ranking only below uses in photographic materials and electrical and electronic products categories. Part of the increase since 1973 was attributed to coin blanks fabricated for the Canadian Government to use in its Olympic coin issues. A growing public desire and acceptance for the medallic and commemorative art objects has contributed to a significant increase in consumption.

Industry stocks of silver at yearend were 49.3 million ounces, up 10.9 million ounces from 1973. Treasury bullion stocks in the Bureau of the Mint were 44.03 million ounces at yearend, down 1.1 million ounces, reflecting stocks used in coinage. Silver available to defense contractors from the Defense Department stocks amounted to 6.03 million ounces at yearend. These stocks consisted of fine silver recovered from old scrap items collected mostly from various U.S. military service branches. The total amount of silver in the national stockpile remained at 139.5 million ounces, the same as at yearend 1973. The revised stockpile objective of 21.7 million ounces left 117.8 million ounces as surplus for possible disposal, but Congressional approval is required. During 1974, the General Services Administration (GSA) offered and sold by mail bid, 414,118 silver dollars. These were minted at the Carson City, Nev., mint, which was operated from 1870–93. Of the 2,937,000 Carson City silver dollars originally authorized for sale by GSA, 978,560 silver dollars remained for possible future auction.

Trading volume on the New York Commodity Exchange (COMEX) was 10.62 billion ounces during 1974, a decrease of 1.39 billion ounces compared with that of 1973. The Chicago Board of Trade (CBOT) trading volume was 7.31 billion ounces, a decrease of 0.84 billion ounces from that in 1973. During the year, COMEX warehouse stocks increased 3.5 million ounces to 67.8 million ounces. CBOT stocks decreased 7.9 million ounces to 19.5 million ounces at the end of 1974.

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[1] Physical scientist, Division of Nonferrous Metals.

Table 1.—Salient silver statistics

	1970	1971	1972	1973	1974
United States:					
Mine production ---- thousand troy ounces --	45,006	41,564	37,283	r 37,484	33,762
Value ---- thousands --	$79,697	$64,258	$62,737	r $95,883	$159,018
Ore (dry and siliceous) produced:					
Gold ore -------- thousand short tons --	2,086	1,872	1,579	3,817	2,033
Gold-silver ore ---- do ----	214	167	173	124	65
Silver ore ---- do ----	720	683	564	598	693
Percentage derived from:					
Dry and siliceous ores ----	37	37	31	30	30
Base metal ores ----	63	63	69	70	70
Refinery production [1] thousand troy ounces --	49,451	37,242	38,366	36,494	32,368
Exports [2] ---- do ----	27,614	12,224	29,657	11,215	18,390
Imports, general [2] ---- do ----	62,300	57,962	65,406	130,681	133,396
Stocks Dec. 31:					
Treasury [3] -------- million troy ounces --	25	48	46	45	44
Industry [4] ------ thousand troy ounces --	210,150	185,335	152,255	130,111	136,597
Consumption:					
Industry and the arts ---- do ----	128,404	129,146	r 151,663	r 196,386	177,015
Coinage ---- do ----	709	2,474	2,284	920	1,017
Price [5] ---- per troy ounce --	$1.771	r $1.546	$1.685	$2.558	$4.708
World:					
Production -------- thousand troy ounces --	300,991	294,713	r 301,510	r 308,584	295,562
Consumption: [6]					
Industry and the arts ---- do ----	338,900	351,400	r 388,300	r 471,500	415,000
Coinage ---- do ----	26,900	27,200	r 36,000	r 21,000	33,000

r Revised.

[1] From domestic ores.

[2] Excludes coinage.

[3] Excludes silver in silver dollars.

[4] Includes silver in COMEX and CBOT warehouses.

[5] Average New York price—Source: Handy & Harman.

[6] Market economies only—Source: Handy & Harman.

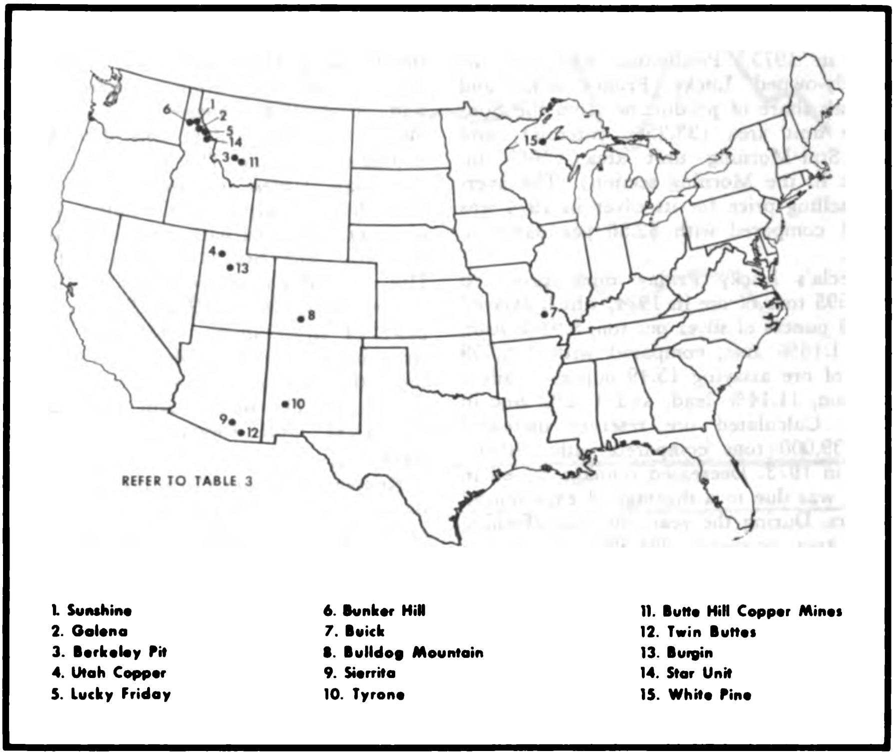

Figure 1.—Major U.S. silver-producing mines.

Legislation and Government Programs.—Legislation was introduced in Congress, but not enacted, to authorize the disposal of 117.8 million ounces of excess silver in the national stockpile.

Silver remained eligible for exploration assistance of up to 75% of approved costs under a program conducted by the Office of Minerals Exploration (OME), U.S. Geological Survey. A few contracts were active in the first half of 1974. No funding was available in the fiscal year 1975–76.

DOMESTIC PRODUCTION

Domestic mine production of recoverable silver was 33.76 million ounces, 3.72 million ounces less than in 1973. A copper mine strike of 1 month, a 2-week shutdown of a mine in Idaho for shaft repairs, and a shortage of skilled miners accounted for much of the decrease in output. Mine production from more than 300 domestic producers was in Idaho, 37%; Arizona, 19%; Montana, 10%; Utah, 10%; Colorado, 8%; Missouri, 7%; New Mexico, 3%; other States, 6%.

The 25 leading silver producers (table 3) accounted for 85% of domestic production. Three of the leading producers mined predominantly silver ores, while the remaining ones mined copper, lead, and zinc ores. Eight of the leading mines produced in excess of 1 million ounces each during the year. Domestic mine production provided 19% of the silver consumed by industry and the arts during 1974.

The Hecla Mining Co., located in the

Coeur d'Alene silver district of Idaho, reported production of 3.58 million ounces of silver, down 0.32 million ounces from that in 1973.[2] Production was from its wholly-owned Lucky Friday mine and Hecla's share of production from the Sunshine unit area (33.25% interest), and the Star-Morning unit area (30% interest in the Morning section). The average selling price for its silver in 1974 was $4.71 compared with $2.56 per ounce in 1973.

Hecla's Lucky Friday mine produced 165,695 tons of ore in 1974, which assayed 13.53 ounces of silver per ton, 9.93% lead, and 1.18% zinc, compared with 176,859 tons of ore assaying 15.49 ounces of silver per ton, 11.14% lead, and 1.22% zinc in 1973. Calculated ore reserves increased to 539,000 tons compared with 510,000 tons in 1973. Decreased tonnage mined in 1974 was due to a shortage of experienced miners. During the year, the Star-Morning unit area produced 281,580 tons of ore compared with 265,781 tons in 1973. Hecla's share was 84,474 tons containing 2.45 ounces of silver per ton, 4.77% lead, and 6.04% zinc compared to 69,734 tons in 1973 assaying 2.79 ounces of silver per ton, 5.18% lead, and 6.68% zinc. Computed ore reserves increased to 336,000 tons compared with 286,000 tons in 1973. Development of the 7,700-foot level, the deepest of the mine, began in early 1974.

The Sunshine Mining Co., operator of the Sunshine unit area, and the nation's leading silver producer in 1974, had an output of 3,845,759 ounces of silver and 445 short tons of antimony concentrate. The Silver Dollar Mining Co. and Hecla Mining Co. each received shares of the Sunshine output.

The Galena mine, also located in the Coeur d'Alene, was the second largest domestic producer in 1974. It was operated by the American Smelting and Refining Company (ASARCO Inc.) and produced 3.49 million ounces of silver compared with 4.19 million ounces in 1973. Production declined due to a shortage of underground labor and a flood on the surface. In June, ASARCO began equipping a new silver mine, the Coeur Shaft Project. Productive capacity was planned at 2.2 million ounces of silver per year and underground development work was proceeding. A new 450-ton-per-day milling facility is scheduled for completion in 1976.

Development work resulted in increased reserves of proven ore at the Bunker Hill and Star mines of the Bunker Hill Co. in the Coeur d'Alene district of Idaho.[3] In 1974, production from company-owned and -controlled mines was 2.2 million ounces of silver, 31,000 tons of lead, and 43,000 tons of zinc. The Bunker Hill mine, the sixth largest domestic producer in 1974, had an output of 1.57 million ounces of silver compared with 2.6 million ounces in 1973. The Star Unit Mine (Bunker Hill and Hecla) produced 0.64 million ounces of silver in 1974. The increased price of silver during the year allowed the mining of lower grade ore so as to extend the life of known reserves of unmined ore. The Bunker Hill Co. is a subsidiary of Gulf Resources & Chemical Corp.

Kennecott Copper Corp. processed 62.09 million tons of copper ore in 1974 and recovered 3.62 million ounces of byproduct silver.[4] This compared with 4.2 million ounces from 66.5 million tons of ore in 1973. Due to severe weather conditions in early 1974, lower grade ore was mined in some areas. Equipment problems in milling and smelting caused substantial losses in production throughout the Metal Mining Division.

The Anaconda Company reported the production of 197,543 tons of copper from which 3.57 million ounces of silver was extracted as a byproduct.[5] In 1974, a growing worldwide surplus of copper and domestic economic recession prompted Anaconda and other U.S. producers to cut base metal prices and curtail production and work force requirements.

Day Mines, Inc. of Wallace, Idaho, owns, leases, or operates approximately 19,000 acres of mining properties in Idaho and Washington.[6] In 1974, silver production from all Day Mines sources amounted to 796,137 ounces, a decrease of 39.5% from 1973 output. Day Mines completed the initial phase of a long-range exploration program designed to strengthen its position as a silver producer.

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[2] Hecla Mining Co. 1974 Annual Report. 29 pp.

[3] Gulf Resources and Chemical Corporation. 1974 Annual Report. 40 pp.

[4] Kennecott Copper Corporation. 1974 Annual Report. 40 pp.

[5] The Anaconda Company. 1974 Annual Report. 36 pp.

[6] Day Mines, Incorporated. 1974 Annual Report. 16 pp.

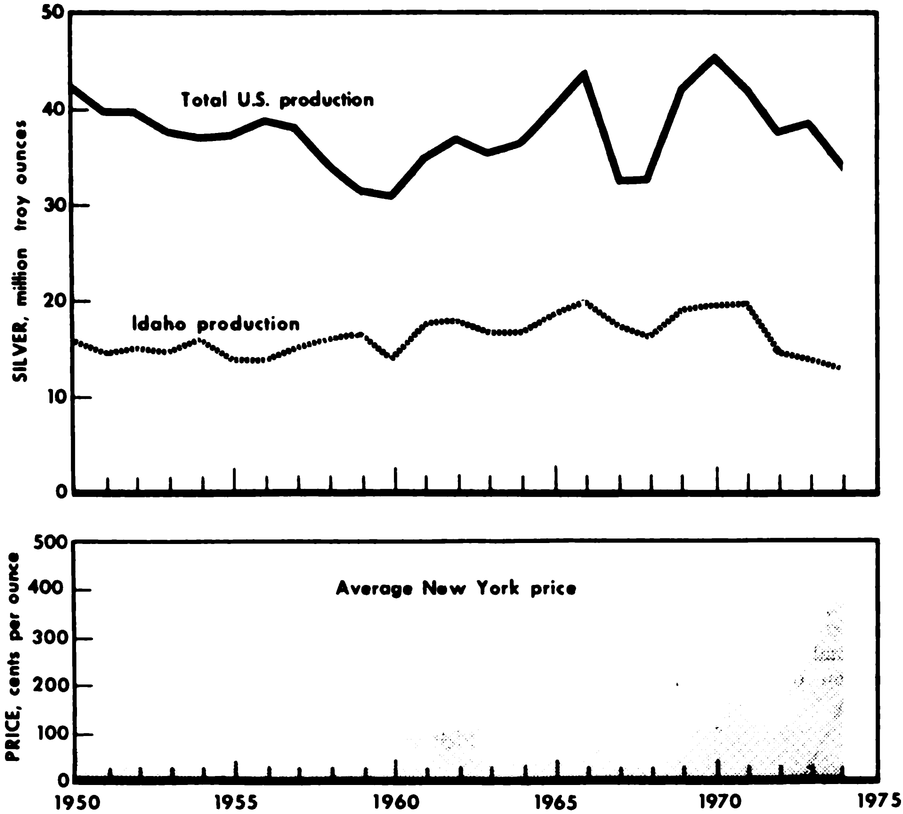

Figure 2.—Silver production in the United States and Idaho and price per ounce.

CONSUMPTION AND USES

Total silver consumed by domestic industry decreased 10% to 177 million ounces in 1974. Significant increases in end uses were reported in mirrors (53%) and catalysts (22%). Moderate increases were evident in commemorative uses, 12%; bearings, 11%; and batteries, 1%. The category of coins, medallions, and commemorative objects has shown expanding usage since 1972.

Six end use categories consumed 86% of the total silver: Photography, 28%; electrical contacts and conductors, 18%; coins and commemorative objects, 13%; sterling ware, 12%; brazing alloys, 8%; and electroplated ware, 7%. The use of silver in coinage increased slightly to 1.02 million ounces compared with 0.92 million ounces in 1973. Silver consumed in coinage was used in the production of proof and uncirculated Eisenhower 40% silver dollars, which were sold to numismatists at premium prices.

Silver used in X-ray film was reported to have declined 10% in 1974 because of high silver prices and improved technology.[7] X-ray film accounted for about 50% of the silver consumed by the photographic industry. The higher price in 1974 also resulted in a greater effort toward silver recovery from spent photographic solutions. Recovery was reported to have been improved to a 90% to 95% rate compared with an 80% rate in 1972.

A new laser-beam recorder using a dry

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[7] American Metal Market. Silver Consumption for X-ray Films Expected to Decline Again in 1975–76. V. 82, No. 127, July 1, 1975, p. 9.

film for computer printout data was developed by Minnesota Mining & Manufacturing Co. This method recorded computer data on a low-cost dry silver microfilm plate instead of conventional computer paper. The images were expected to remain reproducible for up to 25 years. The laser-beam method was an improvement over an earlier COM (computer-output-microfilm) system, which used a wet film process.[8]

American Water Purification, Inc., reported development of a unit containing silver which disinfects the circulating water of a swimming pool.[9] The disinfection involved the combination of the free silver ions in water with the sulfhydrol groups in the enzyme systems of waterborne bacteria, which, when within the cells, blocked the transfer of hydrogen and killed the bacteria. This silver purifier was reported to control both algae and bacteria.

Long-life silver bearings for the thrust reversers of jet planes were developed.[10] These bearings function smoothly under severe pressures and at temperatures up to 1,400° F. Nonsilver bearings used as jet thrusters normally had been replaced after 500 hours of service. The new bearings are made from silver powder, which is combined with smaller amounts of aluminum oxide, phosphate, barium, and calcium fluoride.

STOCKS

The Treasury bullion stock outflow in 1974 was 1.1 million ounces, all of which was consumed in the production of the Eisenhower 40% silverclad dollar. Yearend Treasury stocks were 44.03 million ounces and consisted of bullion, coin bars, and coinage metal fund silver.

Total accountable stocks were 326.2 million ounces. These consisted of 49.3 million ounces in industry stocks, 44.03 million ounces in Treasury stocks, 6.03 million ounces in Department of Defense stocks, 139.5 million ounces in the strategic stockpile, and 87.3 million ounces in COMEX and CBOT registered vaults. Total yearend stocks were up 5.4 million ounces over those in 1973.

PRICES

New York silver prices in 1974, as quoted by Handy & Harman, ranged from a low of 327 cents per ounce on January 4 to a historic high of 670 cents per ounce on February 26 (fig. 2). Average monthly prices declined thereafter until September, when the price stabilized, then remained in the $4 to $5 range for the rest of the year. The average price of silver in 1974 was 470.798 cents per ounce compared with 255.8 cents per ounce in 1973, an increase of 84%.

Worldwide inflation along with domestic recession caused fluctuations in international exchange rates, which resulted in speculative demand for silver. Also, because silver prices were at substantially higher levels than in 1973 and most price increases were passed through to finished products, demand was less for many items.

Prices on the London Silver Market ranged from a low of 328.172 cents per ounce to a high of 723.738 cents per ounce (U.S. equivalent). The average 1974 price was 467.458 cents per ounce, slightly less than the New York average.

Prices continued to advance sharply on silver futures commodity trading exchanges. The trading volume on COMEX was 10.62 billion ounces, a decrease of 1.39 billion ounces from the 1973 volume. On CBOT, trading volume was 7.31 billion ounces, a decrease of 0.84 billion ounces from that in 1973. COMEX announced a reduction of the contract trading unit to 5,000 ounces from 10,000 ounces, effective September 27. Thus, the trading unit on both exchanges was 5,000 ounces from that date.

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[8] Business Week. When a Laser Makes a Printout. No. 2318, Feb. 16, 1974, p. 113.

[9] Silver Institute Letter. V. 4, No. 5, May 1974, p. 2.

[10] Page 2 of reference cited in footnote 9.

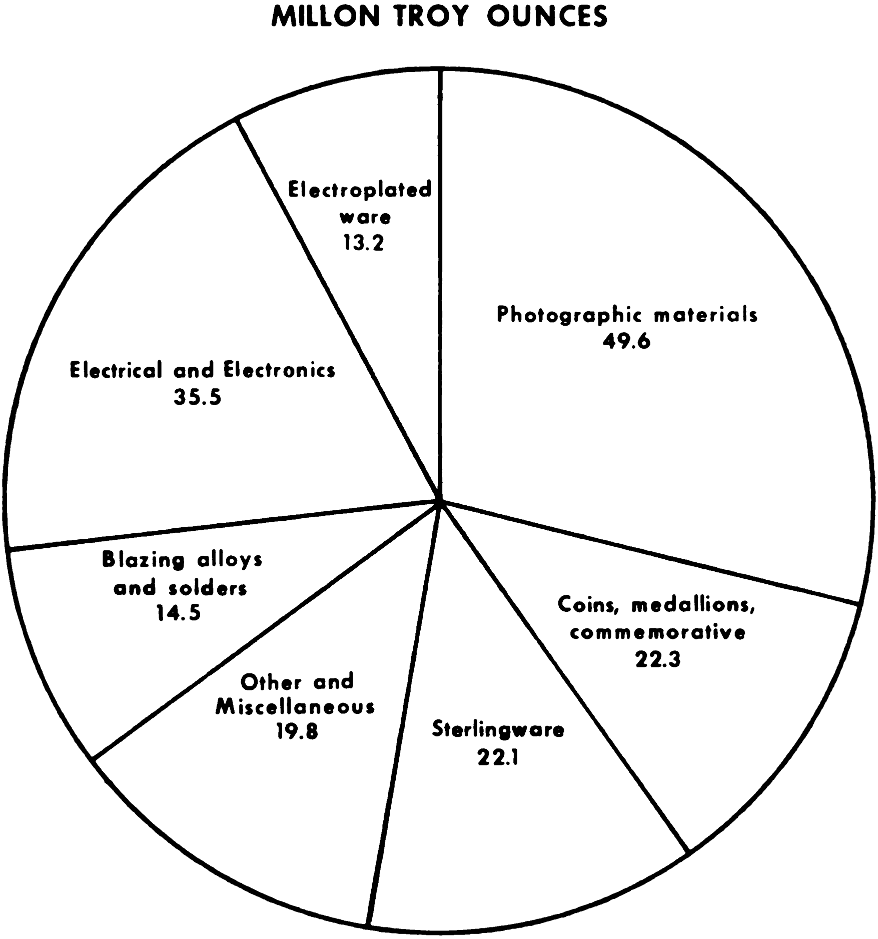

Figure 3.—Silver consumption in the United States, 1974.

FOREIGN TRADE

Exports of silver increased 64% to 18.4 million ounces in 1974. Canada received 45% of total exports; the United Kingdom, 18%; Belgium-Luxembourg, 14%; Japan, 11%; and West Germany, 3%. The remaining 9% went to 14 other countries. A small quantity of silver in ore and concentrates went mostly to West Germany and Canada. Canada, the United Kingdom, and Belgium-Luxembourg were destinations for most of the waste, scrap, and sweepings. Bullion went mainly to Canada, Japan, Brazil, and the United Kingdom. The bullion imported by Canada from the United States in 1974 was almost 4 times that imported in 1972. Part of this was attributed to an increased use in coinage, mainly that in sterling coins commemorating the 1976 Olympic games to be held in Ottawa, Ontario.

Total silver imports increased 2% to 133.4 million ounces. The main sources of imports were Mexico, 29%; Canada, 27%; the United Kingdom, 14%; Peru, 13%; and Japan, 4%. Other countries supplied the remaining 13%. Refined bullion constituted 67% of total imports. Unrefined silver accounted for 33%.

Net imports decreased to 115 million ounces from 119.5 million ounces in 1973, reflecting reduced demand.

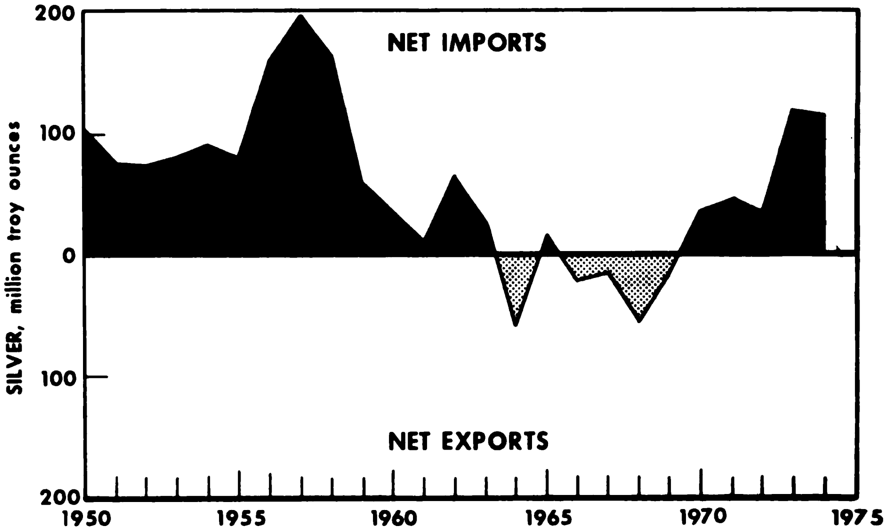

Figure 4.—Net exports or imports of silver, 1950–74.

WORLD REVIEW

World mine production of silver in 1974 was 295.6 million ounces, a decrease of 13.0 million ounces from that in 1973. All major producing countries reported decreases in silver output, partly due to a drop in production of base metals. The Western Hemisphere produced 58% of total world silver mined in 1974.

World consumption of silver in industry and arts decreased to 415 million ounces in 1974 from 472 million ounces in 1973.[11] World coinage, however, increased 12 million ounces, partly because of Canadian production of 1976 Olympic games coin sets. Total consumption by market economy countries exceeded newly mined supply by 175 million ounces, according to Handy & Harman estimates. This supply-demand gap was filled by secondary recovery and liquidation of private and industry stocks.

Australia.—Total silver production was 21.62 million ounces, about 4% less than in 1973. At operations of Mount Isa Mines, Ltd., the country's principal silver producer, production was interrupted during February and March because of surface flooding. Nevertheless, output rose to 9.69 million ounces of silver in 1974 compared with 8.8 million ounces in 1973. ASARCO has a 49% share in Mount Isa Mines, Ltd. Total proven silver-lead-zinc reserves were placed at 56 million tons of extractable ore. The Hilton mine, a silver-lead-zinc deposit owned by Mount Isa, was under gradual development for operation within the next decade. Proven reserves were estimated at 37 million tons of ore. Grade of the ore was unavailable.

The Mount Lyell mine is located in Tasmania and operated by the Mount Lyell Mining and Railway Co., Ltd., a 61% owned subsidiary of Consolidated Gold Fields Australia, Ltd. In 1974, this copper-gold-silver mine produced 3.98 million ounces of silver. Proven reserves were over 30 million tons of ore.

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[11] Handy & Harman. The Silver Market, 1974. 59th Annual Review. 1974, 23 pp.

The Broken Hill and Broken Hill South mines, both silver-lead mines, produced an estimated 3 million ounces of silver in 1974. Estimated reserves for both mines were about 14 million tons of ore.

Canada.—Primary production of silver in 1974 was 42.1 million ounces, 5.4 million ounces less than the record high of 47.5 million ounces in 1973.

The decrease was attributed mainly to reduced mine output caused by labor shortages and depressed base metal operations. Canada maintained its place as the world's leading producer of silver. The main market continued to be the United States, which imported over 80% of Canada's total output.

The Province of Ontario was the leading source, providing over 40% of all silver mined in 1974. The Kidd Creek mine, located at Timmins, Ontario, probably the world's largest single silver producer, produced 10.55 million ounces from 3.61 million tons of ore. Underground operations during the year were equipped with a shaft 3,000 feet in depth with 400-foot drift intervals. Construction was begun on the headframe of a second shaft to extend 5,300 feet in depth. Additional underground work would enable mine production to be increased to about 5 million tons of ore annually.

Mines 6 and 12 of the Brunswick Mining and Smelting Corp., Ltd., at Bathhurst, New Brunswick, produced 4.99 million ounces of silver in 1974. Extensive exploration and a new shaft to a depth of 4,500 feet increased ore reserves to 84.7 million tons at the beginning of 1974. These reserves averaged 9.38% zinc, 3.84% lead, 0.27% copper, and 2.79 ounces of silver per ton. Open pit operations at the No. 6 mine were expected to be terminated in late 1975.

The Sturgeon Lake, Ontario, mine, operated by Mattabi Mines Ltd., produced 3.41 million ounces of silver from 1.1 million tons of ore. Normal operations were hampered by the lack of experienced miners.

In British Columbia, the Sullivan mine at Kimberly produced 1.69 million ounces of silver. Operations were suspended from July 1 to October 31 owing to a strike.

Silver production in the Yukon Territory was about the same as in 1973. United Keno Hill Mines, Ltd., reported production of 3.24 million ounces from the Husky, Elsa, No Cash, Keno, Towsite, Dixie, and Shamrock mines. The Cyprus Anvil Mining Corp. reported 2.25 million ounces output from its Faro mine. Dynasty Exploration Ltd. and Cima Resources, Ltd., continued exploration work in the Hess Mountains area, 110 miles north of the Ross River. Six significant silver-lead mines and vein exposures were being prepared for diamond drilling and further evaluation.

Significant production was reported by Echo Bay Mines Ltd. from a silver-copper mine located at Port Radium on Great Bear Lake, Northwest Territories. Output was 2.12 million ounces of silver. Echo Bay conducted further explorations on an adjoining property. Terra Mining and Exploration Ltd. N.P.L. produced 1.4 million ounces of silver from its underground mine in the Camsell River area.

Dominican Republic.—At the end of 1974, the Pueblo Viejo gold and silver mining and cyanide leaching facilities were nearing completion.[12] Scheduled to operate at 8,000 tons per day, the open pit mine would be the second largest gold producer in the Western Hemisphere, with annual output of 350,000 ounces of gold and a significant output of silver amounting to 1.5 million ounces. Additional drilling information in 1974 established total oxide ore reserves at 30 million tons grading 0.126 ounce of gold and 0.76 ounce of silver per ton. The operator was Rosario Dominicana, S. A., owned by Rosario Resources Corp. (40%), J. R. Simplot and Co. (40%), and the Central Bank of the Dominican Republic (20%).

Honduras.—The El Mochito mine of Rosario Resources Corp. produced 326,248 tons of ore which graded 11.9 ounces of silver and 0.007 ounce of gold per ton, 7.83% lead, and 8.61% zinc.[13] Output of silver amounted to 3.7 million ounces, 16% higher than in 1973. Ore reserves in the Main and Yojoa areas decreased slightly to 1.73 million tons.

India.—India authorized the uncontrolled export of silver bullion, sheets, and plates beginning on February 17, 1974. A trade source reported that 400,000 ounces of silver were exported from Bombay in the first 5 weeks after legalization. During

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[12] Rosario Resources Corporation. 1974 Annual Report. P. 7.

[13] Page 5 of reference cited in footnote 12.

1974, exports and consumption for industrial purposes each were estimated at about 27 million ounces. According to reports, individual reserves held by the Indian public constitute one of the world's largest storehouses of silver.

Japan.—Mine production of silver declined to 7.3 million ounces in 1974, a 14% decrease from 1973 output. Industrial consumption was about 55 million ounces, down 20% from the record high in 1973.[14] No silver was used in coinage. To fill the supply/demand gap, Japan imported about 29 million ounces of silver, mainly from Peru, Mexico, and Australia. Exports were 7.5 million ounces compared with 0.15 million ounces in 1973.

Mexico.—Mine production from Mexico, the world's third largest silver producer, was 37.5 million ounces in 1974, 1.24 million ounces less than that in 1973. Industrias Peñoles, S.A., one of Mexico's two large producers, announced that the discovery of four important new areas for prospecting, along with development of existing areas, would establish Mexico as the world's leading silver producer in 1976. Mexican output in 1976 was projected close to 60 million ounces. Government stocks were estimated at about 8 million ounces at the end of 1974.

Pure Silver Mines Ltd. reported completion of a feasibility study on a 2,000-ton-per-day operation based on proven reserves of about 3.6 million tons of silver-gold ore. Approximately $9 million had been spent on a joint exploration project by Cia. Minera Fresnillo, S.A., and Industrias Peñoles, S.A. (70%), and Pure Silver Mines (30%).

In the Durango area, Minas de San Luis, S.A., reported exploration activity in the La Libertad mine. Several new levels were opened as a result of diamond drilling. Approximately 200,000 tons of ore on or near the Santa Rosa vein were blocked out. The average ore grade was 16.1 ounces of silver and 0.03 ounce of gold per ton. The width of the vein varied between 3 and 8 feet. Preliminary flotation tests indicated a gold and silver recovery rate of 80%.

Tormex Mining Developers reported that the La Encantada mine ore was being milled at the rate of 500 tons per day. Construction and most development were completed in 1974. The main operation was the mining of lower grade ore from the upper levels, which contained 20% lead and 6 ounces per ton in silver. Earlier development indicated La Encantada higher grade ore averaged 40% lead and 30 ounces per ton in silver.

Rosario Mexico, S.A. de C. V., operated the Huautla mine at Morelos. This silver-lead operation was 40% owned and operated by Rosario Resources Corp. With production initiated in 1971, the Huautla project currently contains reserves of 396,224 tons, averaging 19.3 ounces per ton in silver. A new shaft and expanded milling facilities were expected to be completed at the end of 1976.

Industrial Minera Mexico, S.A. (formerly ASARCO Mexicana, S.A.), a subsidiary of American Smelting and Refining Company, had a refinery output of 20.7 million ounces of silver in 1974. Mine and plant production provided an increase of 3.5 million ounces of silver over that of 1973. Operations at the mines were normal and ore reserves were increased at the various mining units, except at the Parral mine, where operations ceased in March 1975 for lack of minable ore.

In April ASARCO Mexicana completed the sale of a part of its capital stock in Industrial Minera Mexico, S.A., to Mexican investors, thus reducing its equity to 34% from the 49% formerly owned.[15]

Nicaragua.—Rosario Mining of Nicaragua, Inc., reported intensified exploration efforts in the La Luna area, located about 15 miles from Zeldya. Approximately 1.13 million tons of proven and probable ore reserves averaged 0.087 ounce of gold and 4.39 ounces of silver per ton. Diamond drilling was continuing to develop additional gold-silver reserves.[16]

Peru.—Peru maintained its position as the second largest silver producer in 1974. Mine production was 41 million ounces, down about 1 million ounces from 1973. Silver produced in Peru was a byproduct of base metal production, mainly copper.

The Cerro Corp. announced that its subsidiary, Cerro de Pasco Corp. was expropriated on January 1, 1974, by the Peruvian Government.[17] Negotiations were concluded successfully by an emissary of the U.S. Government. The Cerro Corp. stated that Cerro de Pasco received a cash payment of $67 million covering partial compensation for the company. The Cerro Corp. intended to continue its commercial relationship with the Government of Peru. It expected to provide purchasing services to Empresa Minera del Centro del Peru, the Peruvian marketing organization and successor to Cerro de Pasco.

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[14] Page 15 of reference cited in footnote 11.

[15] American Smelting and Refining Company. 1974 Annual Report. Pp. 16–17.

[16] Page 11 of reference cited in footnote 12.

[17] Skillings Mining Review. Mar. 2, 1974, p. 12.

Financing for the Cuajone copper project of Southern Peru Copper Corp. was completed in July 1974.[18] The Cuajone project reached about 65% completion by yearend. When completed, the facility will have an annual capacity of 170,000 short tons of blister copper and a substantial quantity of byproduct silver.

TECHNOLOGY

Researchers at the Bureau of Mines Reno Metallurgy Research Center conducted investigations of improved processes for recovering silver from low-grade and refractory ores. Techniques were expected to be applicable to deposits not large enough to justify the capital expenditure required for conventional processing. Research continued on methods of desorbing silver and gold from activated carbon using alkaline alcohol solutions. An improved chloridizing roasting-cyanidation process sequence for the recovery of silver from a complex refractory ore containing silver-bearing jarosite and manganese minerals appeared promising. Also, an improved procedure was developed for chloridizing silver ore at modest roasting temperatures. A 90% silver extraction was attained using cyanidation on calcines, which had been chloridized at 400° C in an airstream saturated with water vapor.

The Bureau of Mines released a report on its continuing ground support studies in the Coeur d'Alene silver district of Idaho.[19] The report described fieldwork and analyses necessary to determine physical properties, stress distribution, and other aspects of rock behavior for the evaluation of support requirements for a typical mine opening. The work was conducted in the Crescent mine near Wallace, Idaho. Conventional overcore techniques with a three-component borehole deformation gage developed by the Bureau were used in three drill holes. The overcore theory, which predicts that a similar deformation effect occurs in the wall rock around the perimeter of an opening in rock under stress, was sustained upon analysis of overcore rock samples.

Hecla Mining Co. developed an improved method to prevent dust from blowing over surrounding areas from filled tailing ponds. Most of the liquid waste pumped into the ponds consisted of silt and smaller suspended fractions. An asphalt emulsion was applied to the surface which was stabilized as the water evaporated. Vegetative cover was compatible with the asphalt emulsion, further limiting future dust problems.

A Japanese firm developed a new method of recovering silver from spent color photographic solutions. Developing solutions which had lost their ability to develop film because of a build-up of silver and iron were treated with either iron sulfide or cobalt sulfide. The dissolved silver and iron were recovered, permitting reuse of the developing solution. The developing time was increased 10 seconds over that of a newly prepared solution.

An improved silver solder alloy, which provided better solder connections in the manufacture of ceramic capacitors, was developed by a Japanese metal company. The solder consisted of silver, cadmium, tin, and lead. The low melting point (about 392° F) allowed soldering of the electrodes at low temperatures without cracking of the ceramic. Silver in the alloy also reduced the tendency of the solder to dissolve the silver electrodes attached to the capacitor.

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[18] Pages 15–16 of reference cited in footnote 15.

[19] Skinner, E. H., G. G. Wadell, and J. P. Conway. In Situ Determination of Rock Behavior by Overcore Stress Relief Method, Physical Prospects Measurements, and Initial Deformation Method. BuMines RI 7962, 1974, 41 pp.

Table 2.—Mine production of recoverable silver in the United States, by month

(Thousand troy ounces)

Month	1973 r	1974
January	3,208	2,654
February	3,186	2,921
March	3,109	3,163
April	2,809	3,097
May	3,302	3,123
June	2,926	3,074
July	3,034	2,489
August	3,268	2,101
September	3,164	2,718
October	3,169	2,878
November	3,069	2,753
December	3,245	2,789
Total	37,484	[1] 33,762

r Revised.

[1] Data does not add to total shown because of independent rounding.

Table 3.—Twenty-five leading silver-producing mines in the United States in 1974, in order of output

Rank	Mine	County and State	Operator	Source of silver
1	Sunshine	Shoshone, Idaho	Sunshine Mining Co	Silver ore.
2	Galena	do	American Smelting and Refining Company	Do.
3	Berkeley Pit	Silver Bow, Mont	The Anaconda Company	Copper, silver ore.
4	Utah Copper	Salt Lake, Utah	Kennecott Copper Corp	Copper, gold ore.
5	Luck Friday	Shoshone, Idaho	Hecla Mining Co	Lead ore.
6	Bunker Hill	do	Bunker Hill Co	Lead-zinc ore.
7	Buick	Iron, Mo	Pima Mining Co	Do.
8	Bulldog Mountain	Mineral, Colo	Homestake Mining Co	Silver ore.
9	Sierrita	Pima, Ariz	Duval Sierrita Corp	Copper ore.
10	Tyrone	Grant, N. Mex	Phelps Dodge Corp	Do.
11	Butte Hill Copper Mines	Silver Bow, Mont	The Anaconda Company	Do.
12	Twin Buttes	Pima, Ariz	Anamax Mining Co	Do.
13	Burgin	Utah, Utah	Kennecott Copper Corp	Lead-zinc ore.
14	Star Unit	Shoshone, Idaho	Bunker Hill Co. and Hecla Mining Co.	Do.
15	White Pine	Ontonagon, Mich	White Pine Copper Co	Copper ore.
16	Pima	Pima, Ariz	Pima Mining Co	Do.
17	Magma	Pinal, Ariz	Magma Copper Co	Do.
18	San Manuel	do	do	Do.
19	Mission Unit	Pima, Ariz	American Smelting and Refining Company	Do.
20	Morenci	Greenlee, Ariz	Phelps Dodge Corp	Do.
21	Idarado	Ouray and San Miguel, Colo	Idarado Mining Co	Copper-lead-zinc ore.
22	Pan American	Lincoln, Nev	St. Patrick Mining Co., Inc	Lead-zinc ore.
23	Copper-Queen-Lavender Pit	Cochise, Ariz	Phelps Dodge Corp	Copper ore.
24	Magmont	Iron, Mo	Cominco American, Inc	Lead ore.
25	Ray Pit	Pinal, Ariz	Kennecott Copper Corp	Copper ore.

Table 4.—Production of silver in the United States in 1974, by State, type of mine, and class of ore, yielding silver, in terms of recoverable metal

State	Placer (troy ounces of silver)	Lode					
		Gold ore		Gold-silver ore		Silver ore	
		Short tons	Troy ounces of silver	Short tons	Troy ounces of silver	Short tons	Troy ounces of silver
Alaska	351	--	--	--	--	--	--
Arizona	--	17,453	424	--	--	16,790	4,940
California	272	2,006	4,927	2,468	18,187	100	3,108
Colorado	--	10,004	166	W	W	205,957	1,412,987
Idaho	--	652	805	1,645	4,290	440,129	7,824,549
Michigan	--	--	--	--	--	--	--
Missouri	--	--	--	--	--	--	--
Montana	21	4,467	6,849	21,388	91,474	29,457	131,508
Nevada	--	265,009	5,052	12,704	38,544	254	15,005
New Mexico	--	--	--	W	W	--	--
New York	--	--	--	--	--	--	--
Oregon	--	2,901	1,857	3,304	6,496	52	572
South Dakota	--	1,559,691	62,474	--	--	--	--
Tennessee	--	--	--	--	--	--	--
Other States [1]	--	170,347	130,394	23,168	232,533	14	650
Total	644	2,032,530	212,948	64,677	391,524	692,753	9,393,319
Percent of total silver	([2])	--	1	--	1	--	28

State	Lode—Continued					
	Copper ore		Lead ore		Zinc ore	
	Short tons	Troy ounces of silver	Short tons	Troy ounces of silver	Short tons	Troy ounces of silver
Alaska	20	196	--	--	--	--
Arizona	161,064,086	6,266,783	712	1,008	667	1,202
California	24	9	217	1,174	--	--
Colorado	W	W	3,110	5,303	195,563	116,945
Idaho	86,099	22,162	190,000	2,484,635	10,021	1,430
Michigan	8,300,913	642,944	--	--	--	--
Missouri	--	--	9,110,057	2,387,250	--	--
Montana	23,141,975	3,249,733	289	2,587	792	2,323
Nevada	13,467,158	401,127	2,270	2,000	50	470
New Mexico	26,343,262	1,040,205	16	29	W	W
New York	--	--	--	--	1,099,780	64,463
Oregon	--	--	--	--	--	--
South Dakota	--	--	--	--	--	--
Tennessee	--	--	--	--	--	--
Other States [1]	35,607,829	2,463,609	--	--	823,713	142,609
Total	268,011,366	14,086,768	9,306,671	4,883,986	2,130,586	329,442
Percent of total silver	--	42	--	14	--	1

State	Lode—Continued					
	Copper-lead, lead-zinc, copper-zinc, and copper-lead-zinc ores		Old tailings, etc.		Total [3]	
	Short tons	Troy ounces of silver	Short tons	Troy ounces of silver [4]	Short tons	Troy ounces of silver
Alaska	--	--	--	--	20	547
Arizona	97,723	59,308	67,249	21,863	161,264,680	6,355,528
California	800	3,247	3	10,970	5,618	41,894
Colorado	860,900	1,045,027	32,180	77,364	1,321,489	2,783,978
Idaho	1,037,704	2,097,752	2	78	1,766,252	12,435,701
Michigan	--	--	--	--	8,300,913	642,944
Missouri	--	--	--	--	9,110,057	2,387,250
Montana	212	2,251	9,020	25,415	23,207,600	3,512,161
Nevada	301,688	409,982	10	63	14,049,143	872,243
New Mexico	W	W	--	--	26,526,049	1,194,800
New York	--	--	--	--	1,099,780	64,463
Oregon	--	--	--	--	6,257	8,925
South Dakota	--	--	--	--	1,559,691	62,474
Tennessee	1,153,035	20,053	--	--	1,153,035	20,053
Other States [1]	405,630	686,396	29	3,474	36,834,184	3,378,913
Total	3,857,692	4,324,016	108,493	139,227	286,204,768	33,761,874
Percent of total silver	--	13	--	([2])	--	100

W Withheld to avoid disclosing individual company confidential data included in "Other States."

[1] Includes Illinois, Maine, Oklahoma, Utah, Washington, Wisconsin and States indicated by symbol "W".

[2] Less than ½ unit.

[3] Data may not add to State totals due to items withheld to avoid disclosing individual company confidential data.

[4] Includes byproduct silver recovered from tungsten ore in California and fluorspar in Illinois.

Table 5.—Mine production of recoverable silver in the United States, by State

(Troy ounces)

State	1970	1971	1972	1973	1974
Alaska	2,189	868	288	828	547
Arizona	7,330,417	6,169,623	6,652,800	7,199,251	6,355,528
California	451,150	443,761	175,467	55,897	41,894
Colorado	2,933,363	3,389,748	3,663,832	r 3,598,209	2,783,978
Idaho	19,114,829	19,139,575	14,250,725	13,619,824	12,435,701
Maine	63,227	41,193	16,251	W	W
Michigan	891,579	670,052	785,100	850,273	642,944
Missouri	1,816,978	1,660,879	1,971,530	2,057,732	2,387,250
Montana	4,304,326	2,747,557	3,325,052	4,349,869	3,512,161
Nevada	718,011	601,470	595,351	623,660	872,243
New Mexico	781,952	782,441	1,016,880	1,111,269	1,194,800
New York	23,830	17,928	25,070	54,345	64,463
Oregon	3,594	3,790	2,252	1,282	8,925
South Dakota	119,766	106,785	99,992	71,939	62,474
Tennessee	94,770	131,349	83,466	73,104	20,053
Utah	6,029,737	5,294,477	4,299,604	3,619,038	3,207,923
Other States	325,887	362,646	269,262	197,050	170,990
Total	45,005,605	41,564,142	37,232,922	r 37,483,570	33,761,874

r Revised. W Withheld to avoid disclosing individual company confidential data; included with "Other States."

Table 6.—Silver produced in the United States from ore, old tailings, etc., in 1974, by State and method of recovery, in terms of recoverable metal

State	Total ore, old tailings, etc., treated [1] [2] (thousand short tons)	Ore and old tailings to mills					Crude ore, old tailings, etc., to smelters [1]	
		Thousand short tons [1] [2]	Recoverable in bullion		Concentrates smelted and recoverable metal			
			Amalgamation (troy ounces)	Cyanidation (troy ounces)	Concentrates (short tons)	Troy ounces	Thousand short tons	Troy ounces
Alaska	(3)	--	--	--	--	--	(3)	196
Arizona	[4] 179,096	[4] 178,685	--	2,240	3,119,674	6,257,810	411	95,478
California	5	3	--	--	639	35,490	2	6,132
Colorado	[5] 1,321	[5] 1,312	2,379	178,615	152,124	2,505,312	9	97,672
Idaho	1,767	1,764	8	--	160,178	12,419,853	3	15,840
Michigan	8,301	8,301	--	--	230,336	642,944	--	--
Missouri	9,110	9,110	--	--	987,154	2,387,250	--	--
Montana	23,232	23,141	--	--	441,231	3,245,603	91	266,537
Nevada	[4] [5] 23,110	[4] [5] 23,054	80	38,694	371,356	815,516	56	17,953
New Mexico	26,558	26,463	--	--	874,924	1,167,446	95	27,354
New York	1,232	1,232	--	--	180,177	64,463	--	--
Oregon	6	(3)	--	20	--	--	6	8,905
South Dakota	1,560	1,560	--	62,474	--	--	--	--
Tennessee	4,246	4,246	--	--	194,603	20,053	--	--
Other States [6]	[4] 36,923	[4] 36,725	--	53,905	864,317	3,008,266	198	316,742
Total	316,467	315,596	2,467	335,948	7,576,713	32,570,006	871	852,809

[1] Includes some nonsilver-bearing ore not separable.

[2] Excludes tonnages of fluorspar, tungsten, and uranium ores from which silver was recovered as a byproduct.

[3] Less than ½ unit.

[4] Includes ore from which silver was recovered by vat leaching.

[5] Includes ore from which silver was recovered by heap leaching.

[6] Includes Illinois, Maine, Oklahoma, Utah, Washington, and Wisconsin.

Table 7.—Silver produced at amalgamation and cyanidation mills in the United States and percentage of silver recoverable from all sources

Year	Bullion and precipitates recoverable (troy ounces)		Silver recoverable from all sources (percent)			
	Amalgamation	Cyanidation	Amalgamation	Cyanidation	Smelting[1]	Placers
1970	95,287	24,892	0.21	0.05	99.73	0.01
1971	993	106,785	(2)	.26	99.74	(2)
1972	2,490	99,992	.01	.27	99.72	(2)
1973 r	3,536	260,846	.01	.70	99.29	(2)
1974	2,467	335,909	.01	.99	99.00	(2)

r Revised.

[1] Crude ores and concentrates.

[2] Less than ½ unit.

Table 8.—Silver produced at refineries in the United States, by source
(Thousand troy ounces)

Source	1973	1974
Concentrates and ores:		
Domestic	36,494	32,368
Foreign	38,877	30,970
Total	75,371	63,338
Old scrap:		
Coins	3,648	15,900
Other	30,907	38,150
Total	[1] 34,556	54,050
New scrap	41,348	51,874
Total production	151,275	[1] 169,278

[1] Data does not add to total shown because of independent rounding.

Table 9.—U.S. consumption of silver, by end use
(Thousand troy ounces)

Final use[1]	1972 r	1973 r	1974
Electroplated ware	12,716	14,542	13,179
Sterling ware[1]	26,493	29,386	22,147
Jewelry	4,871	5,778	5,235
Photographic materials	38,251	51,979	49,579
Dental and medical supplies	1,991	3,022	2,401
Mirrors	1,226	2,579	3,947
Brazing alloys and solders	12,214	17,736	14,514
Electrical and electronic products:			
Batteries	6,044	4,155	4,195
Contacts and conductors	36,434	40,209	31,318
Bearings	344	375	416
Catalysts	3,430	5,988	7,293
Coins, medallions, commemorative objects	7,143	20,108	22,272
Miscellaneous[2]	508	528	519
Total net industrial consumption[3]	151,663	196,386	177,015
Coinage	2,284	920	1,017
Total consumption[3]	153,947	197,306	178,031

r Revised.

[1] End use as reported by converters of refined silver.

[2] Includes silver-bearing copper, silver-bearing lead anodes, ceramics, paints, etc.

[3] Data may not add to total shown because of independent rounding.

Table 10.—Price of silver in New York, 1874–1974[1]

(Dollars per troy ounce)

Calendar year	High	Low	Average	Calendar year	High	Low	Average
1874	1.29375	1.25500	1.27195	1924	0.72375	0.63000	0.67111
1875	1.26125	1.21000	1.23883	1925	.73187	.66812	.69406
1876	1.26000	1.03500	1.14950	1926	.68937	.51812	.62428
1877	1.26000	1.16000	1.19408	1927	.60312	.54187	.56680
1878	1.20750	1.08500	1.15429	1928	.63937	.56812	.58488
1879	1.16750	1.06500	1.12088	1929	.57812	.46812	.53306
1880	1.15000	1.11250	1.13931	1930	.46875	.30750	.38154
1881	1.14500	1.11000	1.12823	1931	.37250	.25750	.28701
1882	1.15000	1.09000	1.13855	1932	.31000	.24250	.27892
1883	1.11750	1.09500	1.10874	1933	.45000	.24500	.34727
1884	1.13250	1.08000	1.11161	1934	.55750	.41750	.47973
1885	1.09500	1.02750	1.06428	1935	.81000	.49750	.64273
1886	1.03500	.92500	.99880	1936	.49750	.44750	.45087
1887	1.03500	.95000	.97899	1937	.46750	.44750	.44883
1888	.97750	.92000	.94300	1938	.44750	.42750	.43225
1889	.97250	.92500	.93634	1939	.42750	.34750	.39082
1890	1.20500	.95750	1.05329	1940	.35625	.34750	.34773
1891	1.07500	.94750	.99033	1941	.35125	.34750	.34783
1892	.95250	.83000	.87552	1942	.44750	.35125	.38333
1893	.85000	.65000	.78219	1943	.44750	.44750	.44750
1894	.70000	.59500	.64043	1944	.44750	.44750	.44750
1895	.69000	.60000	.66268	1945	.70750	.44750	.51928
1896	.70250	.65625	.68195	1946	.90125	.70750	.80151
1897	.66125	.52750	.60774	1947	.86250	.59750	.71820
1898	.62250	.55125	.59064	1948	.77500	.70000	.74361
1899	.64750	.58625	.60507	1949	.73250	.70000	.71930
1900	.65750	.59750	.62065	1950	.80000	.71750	.74169
1901	.64500	.54750	.59703	1951	.90160	.80000	.89368
1902	.56875	.47875	.52815	1952	.88000	.82750	.84941
1903	.62375	.47500	.54208	1953	.85250	.83250	.85188
1904	.62500	.53375	.57843	1954	.85250	.85250	.85250
1905	.66500	.55625	.61008	1955	.92000	.85250	.89099
1906	.72375	.63125	.67379	1956	.91625	.90000	.90826
1907	.71000	.52750	.65978	1957	.91375	.89625	.90820
1908	.58875	.48250	.53496	1958	.90375	.88625	.89044
1909	.54500	.50750	.52163	1959	.91625	.89875	.91202
1910	.57625	.50750	.54245	1960	.91375	.91375	.91375
1911	.57500	.52125	.54002	1961	1.04750	.91375	.92449
1912	.65625	.55250	.62006	1962	1.22000	1.01250	1.08521
1913	.65125	.58000	.61241	1963[2]	1.29300	1.21000	1.27912
1914	.60875	.49000	.56331	1964[2]	1.29300	1.29300	1.29300
1915	.58000	.47750	.51062	1965[2]	1.29300	1.29300	1.29300
1916	.79125	.57250	.67151	1966[2]	1.29300	1.29300	1.29300
1917	1.16500	.73125	.84000	1967[2]	2.17000	1.29300	1.54968
1918	1.01937	.88937	.98445	1968	2.56500	1.81000	2.14460
1919	1.38250	1.01375	1.12087	1969	2.02500	1.54000	1.79067
1920	1.37875	.60375	1.01940	1970	1.93000	1.57200	1.77082
1921	.73813	.53188	.63096	1971	1.75200	1.28800	1.54564
1922	.74188	.62875	.67934	1972	2.04800	1.38700	1.68455
1923	.69000	.62875	.65239	1973	3.28000	1.96200	2.55756
				1974	6.70000	3.27000	4.70798

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[1] Prices are as follows:

1874–1917:	Asked price per fine ounce (unrefined).
1918–29:	Mean of bid and asked prices per fine ounce (unrefined).
1930–61:	Official quotations per ounce 999/1000 fine (unrefined).
1962–66:	Official quotations per ounce 999/1000 fine (refined). Quotations for refined silver are one-fourth cent above prices for unrefined silver.

[2] The price of $1.293 per ounce was effective continuously from September 9, 1963, through May 18, 1967.

NOTE.—There was no open-market price of silver as such in the United States under the bimetallic monetary standard which existed from April 2, 1792, until February 12, 1873. The ratios of the silver dollars to the gold dollar in this period were as follows:

Act of—	Ratio of silver to gold
April 2, 1792	15 to 1
June 28, 1834	16.002 to 1
January 18, 1837	15.988+ to 1

Source: Annual Report of the Director of the Mint, Washington, D.C.

Table 11.—Value of silver exported from and imported into the United States
(Thousand dollars)

Year	Exports	Imports
1972	49,260	101,580
1973	27,638	330,456
1974	81,651	623,794

Table 12.—U.S. exports of silver in 1974, by country
(Thousand troy ounces and thousand dollars)

Country	Ore and concentrates		Waste and sweepings		Refined bullion	
	Quantity	Value	Quantity	Value	Quantity	Value
Argentina	--	--	--	--	131	689
Belgium-Luxembourg	7	15	2,515	11,589	--	--
Brazil	--	--	--	--	483	2,519
Canada	10	21	4,911	23,549	3,428	17,374
Colombia	--	--	--	--	2	9
Costa Rica	--	--	--	--	(1)	1
Dominican Republic	--	--	(1)	2	--	--
France	--	--	--	--	(1)	(1)
Germany, West	36	182	567	2,578	--	--
Hong Kong	--	--	--	--	1	5
Israel	--	--	10	27	--	--
Italy	--	--	79	377	61	94
Japan	--	--	822	3,761	1,223	5,452
Netherlands	--	--	521	2,451	--	--
New Zealand	--	--	--	--	1	3
Sweden	--	--	187	617	--	--
Switzerland	--	--	112	452	30	70
Taiwan	--	--	--	--	(1)	2
United Kingdom	--	--	2,922	8,335	331	1,477
Total	53	218	12,646	53,738	5,691	27,695

[1] Less than ½ unit.

Table 13.—U.S. general imports of silver in 1974, by country

(Thousand troy ounces and thousand dollars)

Country	Ore and concentrates		Waste and sweepings		Dore and precipitates		Refined bullion	
	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value
Argentina	--	--	109	314	--	--	--	--
Australia	3,025	13,540	--	--	--	--	48	259
Belgium-Luxembourg	--	--	18	89	--	--	2,256	9,607
Bermuda	--	--	--	--	2	1	--	--
Bolivia	(1)	(1)	--	--	--	--	--	--
Canada	12,103	53,705	2,701	12,232	1,131	5,375	20,242	95,953
Chile	1,685	4,994	32	158	--	--	445	1,940
Colombia	1	6	--	--	--	--	--	--
France	--	--	(1)	2	--	--	1,046	4,980
Germany, West	--	--	27	110	(1)	(1)	1,038	5,823
Greece	--	--	2	3	--	--	--	--
Guatemala	--	--	--	--	--	--	3	18
Honduras	2,267	10,103	--	--	153	647	--	--
Hong Kong	--	--	(1)	(1)	--	--	--	--
India	--	--	--	--	66	309	573	2,849
Italy	--	--	1	5	--	--	--	--
Jamaica	--	--	--	--	--	--	3	17
Japan	69	319	522	1,506	517	2,465	4,150	19,710
Kenya	2	16	--	--	--	--	--	--
Mexico	1,964	9,704	977	4,112	280	1,359	35,332	163,831
Netherlands	--	--	4	3	--	--	12	70
Nicaragua	57	210	--	--	15	65	--	--
Norway	82	188	--	--	--	--	--	--
Panama	--	--	--	--	--	--	4	4
Peru	12,147	51,808	--	--	161	635	4,458	19,187
Philippines	248	1,213	57	257	--	--	--	--
Poland	--	--	--	--	--	--	8	39
Singapore	--	--	5	16	--	--	--	--
South Africa, Republic of	955	4,457	--	--	--	--	--	--
Switzerland	--	--	--	--	1	3	611	3,310
United Kingdom	18	71	1,567	10,051	82	187	17,573	94,758
Yugoslavia	--	--	484	788	--	--	2,166	10,513
Total	34,568	150,284	6,506	29,646	2,358	10,996	89,968	432,868

[1] Less than ½ unit.

Table 14.—Silver: World production by country[1]

(Thousand troy ounces)

Country[2]	1972	1973	1974 p
North and Central America:			
Canada	44,792	47,488	42,079
Costa Rica	--	(3)	3
El Salvador	177	123	168
Guatemala	6	r e 10	e 10
Haiti e	17	17	20
Honduras	3,595	3,152	3,661
Mexico	37,483	38,788	37,546
Nicaragua	357	180	270
United States	37,233	37,484	33,762
South America:			
Argentina	r 3,274	2,441	e 2,400
Bolivia[4]	5,581	5,803	5,385
Brazil	r 320	322	251
Chile	4,689	5,035	6,646
Colombia	70	75	75
Ecuador	69	57	35
Peru	40,188	42,021	41,000
Europe:			
Austria[5]	192	192	--
Czechoslovakia e	1,100	1,100	1,100
Finland	625	793	811
France	r 4,210	4,176	[5] 3,328
Germany, East e	5,000	r 4,000	3,000
Germany, West	r 1,756	1,446	1,228
Greece[5]	r 371	588	575
Hungary e	6	7	7
Ireland	1,553	1,839	1,980
Italy	2,170	1,349	1,318
Poland e	r 4,000	r 4,800	6,000
Portugal	230	108	e 150
Romania e	1,000	1,100	1,100
Spain	3,036	3,635	e 3,600
Sweden	4,255	4,690	e 4,500
U.S.S.R. e [5]	40,000	41,000	42,000
Yugoslavia	3,582	4,302	4,702
Africa:			
Algeria e	r 210	170	200
Kenya	--	(3)	20
Morocco	3,376	[6] 3,518	[6] 3,137
Rhodesia, Southern[7]	126	169	156
South Africa, Republic of	3,294	3,652	2,994
South-West Africa, Territory of[8]	r 1,360	1,563	[9] 1,556
Tanzania	(3)	(3)	(3)
Tunisia	242	r e 200	136
Zaire	2,078	1,995	1,649
Zambia[10]	109	78	287
Asia:			
Burma	r 1,155	754	722
China, People's Republic of e	800	800	800
India	142	138	e 140
Indonesia	r 304	616	739
Japan	r 10,047	8,552	7,314
Korea, North e	700	700	700
Korea, Republic of	1,770	1,490	1,291
Philippines	1,848	1,892	1,706
Taiwan	74	93	33
Oceania:			
Australia	r 21,888	22,423	21,615
Fiji	24	30	27
New Zealand	31	49	2
Papua and New Guinea	995	1,581	1,628
Total	r 301,510	308,584	295,562

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e Estimate. p Preliminary. r Revised.

[1] Recoverable content of ores and concentrates produced unless otherwise noted.

[2] In addition to the countries listed Bulgaria, Thailand, Turkey and several African countries produce silver, but information is inadequate to make reliable estimates of output levels.

[3] Less than ½ unit.

[4] Includes production by the State mining company (COMIBOL) plus the exports of medium and small (private sector) mines.

[5] Smelter and/or refinery production.

[6] Partly estimated on the basis of silver content of lead ores exported.

[7] Output of Inyati mine only.

[8] Data represent recoverable content of Tsumeb Corp. Ltd. concentrates as well as recovery from copper refinery sludges.

[9] Includes estimate for Klein Aub Koper Maatskappy Ltd.

[10] Includes recovery from copper refinery sludges.

Slag—Iron and Steel

By Harold J. Drake [1]

Processing of iron slag was at a higher level in 1974 than in 1973 despite lower production of pig iron at yearend. The lower output of processed steel slag was more in line with the decrease in steel production that occurred in 1974. Combined output of both types of slag was up 0.5% in quantity and 8% in value over 1973 levels. Production of iron slag rose 4% in quantity and 8% in value, whereas that of steel slag decreased 9% in quantity but increased 4% in value. The trend in recent years toward less processing (other than crushing and screening) continued; tonnage of screened, air-cooled iron slag rose 8%, whereas tonnage of granulated and expanded iron slag declined 5%.

A 5% price increase was recorded for iron slag and a 14% increase for steel slag. Despite price increases, iron and steel slags continued to be strongly competitive with similar construction materials. A sharp gain in exports was recorded; volume rose 40% and value more than tripled. No imports of slag were reported in 1974.

Table 1.—Iron slags processed in the United States, by type
(Thousand short tons and thousand dollars)

Year	Air cooled				Granulated		Expanded		Total	
	Screened		Unscreened							
	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value
1973 ------	23,692	50,737	1,279	1,512	1,999	3,667	1,852	6,936	28,822	62,852
1974 ------	25,557	56,431	669	796	2,081	4,442	1,573	6,461	29,880	68,130

Source: National Slag Association.

DOMESTIC PRODUCTION

The volume of iron slag processed in 1974 totaled 29.9 million tons valued at $68.1 million, compared with 28.8 million tons valued at $62.9 million in 1973. Production of the principal type of iron slag—screened, air-cooled slag—totaled 25.6 million tons valued at $56.4 million, which represented gains of 8% and 11%, respectively, over the production and value levels of 1973. However, output of unscreened, air-cooled material, was nearly halved. Of the approximately 12% of iron slag processed using water techniques, granulated slags rose slightly to 2.1 million tons valued at $4.4 million, whereas expanded slags declined moderately to 1.6 million tons valued at $6.5 million. A portion of the increased output of processed iron slag came from stockpiles. A decline in output at steel operations led to a 9% decline in steel slag to 8.9 million tons. However, the value of steel slag rose 4% to $11.2 million.

A total of 60 companies reported operating 91 air-cooling, 9 expanding, and 10 granulating slag plants in 1974. Slag-encrusted iron reclaimed magnetically by slag processors for resmelting totaled 3,761,000 tons. The 1,551 plant and yard employees in the industry worked a total fo 2,088,545 man-hours.

About 20% of all slag was produced in Pennsylvania, another 20% in Ohio, and another 20% in Illinois, Indiana, and Michigan. The remaining 40% came from a number of States, including Alabama, California, Maryland, and New York.

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[1] Physical scientist, Division of Nonmetallic Minerals.

Table 2.—Iron slag processed in the United States, by State

(Thousand short tons and thousand dollars)

Year and State	Screened and air cooled		All types	
	Quantity	Value	Quantity	Value
1973				
Ohio	5,427	12,316	6,904	14,817
Pennsylvania	5,061	12,032	6,698	16,129
Illinois, Indiana, Michigan	5,945	12,181	6,799	15,174
Other States [1]	7,259	14,208	8,421	16,732
Total	23,692	50,737	28,822	62,852
1974				
Ohio	5,038	12,515	6,109	15,646
Pennsylvania	5,168	12,960	6,712	16,101
Illinois, Indiana, Michigan	5,916	11,841	6,705	15,159
Other States [1]	9,435	19,115	10,354	21,224
Total	25,557	56,431	29,880	68,130

[1] Includes Alabama, California, Colorado, Kentucky, Louisiana, Maryland, Minnesota, New York, Texas, Utah, and West Virginia.

Source: National Slag Association.

CONSUMPTION AND USES

As in past years, nearly all of the slag produced in the manufacture of pig iron and steel was either recycled or used by the construction industry.

An 8% increase in consumption of screened, air-cooled, iron slag was accounted for principally by a 14% increase in shipments for highway and airport construction, a 24% increase in shipments for railroad ballast, and an 18% increase in use for portland-cement concrete construction. Together, these uses accounted for 70% of the total consumption of this type of iron slag. Significant uses that recorded declines were bituminous construction, 6%; concrete block, 31%; mineral wool, 24%; and roofing material, 26%. Consumption of unscreened, air-cooled iron slag was halved, primarily because demand was greater for screened material. The principal use, highway and airport construction, recorded a 13% decline, and numerous other minor applications nearly disappeared.

The volume of granulated and expanded iron slag consumed in construction declined 1.5%. An increase of 4% for granulated slag was offset by a 15% decrease for expanded slag. In its principal use, highway construction, granulated slag was down 2%. In the principal use for expanded slag, concrete block manufacture, consumption was down 16%. Other uses for granulated slag, such as cement and concrete block manufacture, recorded gains. All significant uses of expanded slag recorded declines.

Consumption of steel slag was 9% below that of 1973 and was characterized by sharp fluctuations throughout its range of uses. Use as highway base, railroad ballast, and bituminous mixes was nearly halved in 1974, and significant increases in use as base and fill material, in agriculture, and other applications were not sufficient to offset these losses. More efficient utilization of steel slag was reported in a paper that discussed production and disposal of both iron and steel slags.[2]

A series of rapid wet-chemical methods for the analysis of iron slags was described.[3]

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[2] Drake, H. J., and J. E. Shelton. Disposal of Iron and Steel Slag. Proc. 4th Miner. Waste Utilization Symp., Chicago, Ill., May 7–8, 1974, pp. 303–308.

[3] Jefferson, R. H., E. A. Hattman, and D. J. Kusler. Rapid Wet Chemical Methods for the Analysis of Blast Furnace Slags. BuMines IC 8625, 1974, 15 pp.

Table 3.—Shipments of iron slag in the United States, by method of transportation

Method of transportation	1973		1974	
	Thousand short tons	Percent of total	Thousand short tons	Percent of total
Rail	5,366	19	6,845	23
Truck	22,640	78	21,891	73
Waterway	[r] 816	3	1,144	4
Total	[r] 28,822	100	29,880	100

[r] Revised.

Source: National Slag Association.

Table 4.—Air-cooled iron slag sold or used by processors in the United States, by use

(Thousand short tons and thousand dollars)

Use	1973				1974			
	Screened		Unscreened		Screened		Unscreened	
	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value
Aggregate in—								
Portland cement concrete construction	2,450	5,882	--	--	2,887	7,200	--	--
Bituminous construction (all types)	5,232	11,442	--	--	4,943	11,378	--	--
Highway and airport construction [1]	9,666	20,790	676	1,022	11,025	23,802	589	725
Manufacture of concrete block	628	1,567	1	2	433	1,116	--	--
Railroad ballast	3,256	5,139	--	--	4,027	6,861	--	--
Mineral wool	768	1,812	46	35	585	1,457	--	--
Roofing slag:								
Cover material	299	1,064	--	--	269	947	--	--
Granules	67	530	--	--	3	15	--	--
Sewage trickling filter medium	38	68	--	--	28	55	--	--
Agricultural slag, liming	10	23	--	--	1	2	--	--
Other uses	1,278	2,420	556	453	1,356	3,598	80	71
Total	23,692	50,737	1,279	1,512	25,557	56,431	669	796

[1] Other than in portland cement concrete and bituminous construction.

Source: National Slag Association.

Table 5.—Granulated and expanded iron slags sold or used by processors in the United States, by use

(Thousand short tons and thousand dollars)

Use	1973				1974			
	Granulated		Expanded		Granulated		Expanded	
	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value
Highway construction and fill (road, etc.)	1,397	1,920	--	--	1,376	2,264	--	--
Agricultural slag, liming	64	140	--	--	50	123	--	--
Manufacture of cement (all types)	232	[e] 1,112	195	[e] 585	313	[e] 1,332	179	[e] 626
Lightweight concrete	--	--	25	80	--	--	19	66
Aggregate for concrete-block manufacture	15	70	1,560	6,105	136	418	1,316	5,616
Other uses	291	425	72	166	206	305	59	153
Total	1,999	3,667	1,852	6,936	2,081	4,442	1,573	6,461

[e] Estimated.

Source: National Slag Association.

Table 6.—Steel slag sold or used by processors in the United States, by use[1]

(Thousand short tons and thousand dollars)

Use	1973 Quantity	1973 Value	1974 Quantity	1974 Value
Railroad ballast	1,341	1,691	689	943
Highway base or shoulders	3,241	3,268	1,888	2,445
Paved-area base	1,470	1,499	2,190	2,516
Miscellaneous base or fill	2,263	2,182	2,893	3,027
Bituminous mixes	889	1,296	501	752
Agricultural	115	336	157	707
Other uses	420	493	544	805
Total	9,739	10,765	8,862	11,195

[1] Excludes tonnage returned to furnace for charge material.

Source: National Slag Association.

PRICES

Slag producers reported generally rising prices in 1974 in nearly all slag applications. The overall average f.o.b. plant price for iron slag rose from $2.18 per ton in 1973 to $2.28 per ton in 1974. Similarly, the price of steel slag rose from $1.11 per ton to $1.26 per ton.

The average price of screened, air-cooled iron slag in 1974 was $2.20 per ton compared with $2.14 per ton in 1973. For aggregate use, the average price rose 2% to $2.26 per ton; for railroad ballast, 7% to $1.69 per ton; and for mineral wool, 4% to $2.49 per ton. A 19% decline in the price of unscreened slag used for highway construction was recorded in 1974.

The average prices of granulated and expanded slags were 16% and 10% higher, respectively, than those of 1973. The price of granulated slag used in highway and airport construction, the principal use, rose 20% to $1.64 per ton, whereas prices for other major uses generally declined. Price declines were recorded for expanded slag in most of its uses.

Price increases for steel slag ranged from 4 cents per ton to $1.58 per ton in 1974. For base and fill use, which accounted for about 79% of the total use, the increase averaged 16 cents per ton. The price of steel slag used for ballast rose 11 cents to $1.37 per ton.

Table 7.—Average value of iron slags sold or used by processors in the United States, by use

(Per short ton)

Use	Air cooled				Granulated		Expanded	
	Screened		Unscreened					
	1973	1974	1973	1974	1973	1974	1973	1974
Aggregate in—								
Portland cement concrete construction	$2.40	$2.49	--	--	--	--	--	--
Bituminous construction (all types)	2.19	2.30	--	--	--	--	--	--
Highway and airport construction[1]	2.15	2.16	$1.51	$1.22	$1.37	$1.64	--	--
Manufacture of concrete block	2.50	2.57	2.00	--	4.67	3.14	$3.91	$3.47
Lightweight concrete	--	--	--	--	--	--	3.20	3.29
Railroad ballast	1.58	1.69	--	--	--	--	--	--
Mineral wool	2.40	2.49	.76	--	--	--	--	--
Roofing slag:								
Cover material	3.56	3.52	--	--	--	--	--	--
Granules	7.91	5.00	--	--	--	--	--	--
Sewage trickling filter medium	1.79	1.96	--	--	--	--	--	--
Agricultural slag, liming	2.30	1.00	--	--	2.19	2.46	--	--
Other uses	1.89	2.65	.81	.88	2.94	1.48	3.81	2.55

[1] Other than in portland cement and bituminous construction.

Source: National Slag Association.

FOREIGN TRADE

Exports of iron and steel slag increased sharply to 51,902 tons valued at $2.5 million. Nevertheless, exports were equivalent to only 0.1% of the quantity and 3% of the value of domestic production of slag.

The high unit value for exported slag, $48.63 per ton on the average, were indicative of the high metal content of the material. Increased exports to Canada and Mexico accounted for nearly all of the increase in quantity and value of exports. About 95% of the exported material went to these two countries; Canada alone accounted for 72%. Other countries receiving significant quantities were Belgium-Luxembourg, the United Kingdom, and Australia.

Imports of slag in 1974, if any, were not reported in official statistics.

Table 8.—U.S. exports and imports for consumption of slag, dross, and scaling from the manufacture of iron and steel

Country	1973		1974	
	Short tons	Value	Short tons	Value
Exports:				
Argentina	--	--	61	$555
Australia	271	$2,468	591	6,267
Bahamas	--	--	150	4,950
Belgium-Luxembourg	--	--	544	177,417
Bermuda	--	--	20	700
Canada	34,768	202,293	37,303	1,308,461
Colombia	--	--	14	1,155
Finland	79	720	--	--
Germany, West	100	35,859	--	--
Guatemala	--	--	273	4,777
Guinea	106	970	--	--
Ireland	51	1,428	--	--
Italy	58	20,743	20	695
Japan	--	--	1	611
Mexico	--	--	12,087	835,741
Netherlands	140	70,119	88	1,350
Nigeria	--	--	40	3,000
Pakistan	--	--	46	51,482
South Vietnam	--	--	165	26,758
Tunisia	44	4,032	--	--
United Kingdom	1,495	388,895	461	96,787
Venezuela	5	7,196	38	3,069
Total	37,117	734,723	51,902	2,523,775
Imports: Canada	1,268	13,914	--	--

Sodium and Sodium Compounds

By Charles L. Klingman [1]

A general slowdown of the economy in 1974 decreased demand for soda ash. Outputs of the two major consuming industries, glass and paper, were considerably below normal. Natural soda ash production, derived from Wyoming trona, continued to gain but not as rapidly as predicted; gains were offset by losses in production of synthetic (Solvay) soda ash. Exports of soda ash hit an alltime high at 7.5% of the U.S. production. Sodium sulfate was in moderate demand throughout the year in spite of a 6.6% increase in production, probably because of larger amounts of sodium sulfate in soap and detergent formulations. Imports of sodium sulfate increased from 20% to 22% of the U.S. supply.

Prices for both soda ash and sodium sulfate increased by more than a third during 1974 because of sharply increased costs of fuels, raw materials, and labor.

Major enlargements in production capacity for natural soda ash were continuing, which should increase natural soda ash output 85% by 1978. Overcapacity will probably be avoided, however, by decreases in Solvay production and by development of an active export trade.

Caustic soda, which was interchangeable with soda ash in some applications, was in short supply during the latter part of 1974 because of decreased demand for its coproduct, chlorine. Soda ash was needed to substitute for caustic soda in some instances.

Legislation and Government Programs.—A tax benefit, the depletion allowance, was denied in 1971 to producers of natural soda ash who used "decarbonation" to purify their products. This step of soda ash production was ruled to be processing rather than mining. In 1974, however, the tax benefit was restored to soda ash producers by Public Law 93–499 in which the term "mining" was redefined to include decarbonation.[2]

Federal control of prices of sodium compounds was discontinued April 1, 1974.

DOMESTIC PRODUCTION

The total quantity of soda ash produced in 1974, the sum of both natural and synthetic, was almost identical to that of 1972 and 1973 at 7,561,000 short tons. Natural soda ash production increased 9%; synthetic decreased 8%; and the fraction of soda ash coming from natural sources increased from 49% in 1973 to 54% of the total in 1974. A general economic slowdown in 1974, coupled with higher soda ash prices, had a softening effect on demand.

There were five synthetic soda ash plants in the United States with a combined capacity of about 3.25 million tons per year. Synthetic soda ash required much more energy per ton of output than did the natural product; the current energy shortage, coupled with higher energy prices, put the Solvay plants at an economic disadvantage.

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[1] Physical scientist, Division of Nonmetallic Minerals.

[2] Chemical Marketing Reporter. Trona Depletion Benefit is Reinstated by Congress. V. 206, No. 22, Nov. 25, 1974, p. 4.

Table 1.—Manufactured and natural sodium carbonates produced in the United States

(Thousand short tons and thousand dollars)

Year	Manufactured soda ash (ammonia-soda process) [1] [2]	Natural sodium carbonates [3]		Total quantity
	Quantity	Quantity	Value	
1970	4,393	2,678	56,320	7,071
1971	4,298	2,865	60,774	7,163
1972	[r] 4,305	3,218	71,689	[r] 7,523
1973	[r] 3,813	3,722	94,385	[r] 7,535
1974	[p] 3,502	4,059	137,486	7,561

[p] Preliminary. [r] Revised.

[1] U.S. Bureau of the Census. Current Industrial Reports, Inorganic Chemicals.

[2] Includes quantities used to manufacture caustic soda, sodium bicarbonate, and finished light and dense soda ash.

[3] Soda ash and trona (sesquicarbonate).

Table 2.—Sodium sulfate produced and sold or used by producers in the United States [1]

(Thousand short tons and thousand dollars)

Year	Production (manufactured and natural) [2]			Sold or used by producers (natural only)	
	Lower purity [3] (99% or less)	High purity	Total quantity	Quantity	Value
1970	561	812	1,373	598	10,932
1971	514	843	1,357	688	11,008
1972	526	801	1,327	701	11,396
1973	[r] 551	[r] 754	[r] 1,305	672	11,597
1974	[p] 524	867	1,391	684	16,411

[p] Preliminary. [r] Revised.

[1] All quantities converted to 100% Na_2SO_4 basis.

[2] U.S. Bureau of the Census. Current Industrial Reports, Inorganic Chemicals.

[3] Includes Glauber's salt.

Total production capacity for natural soda ash plants in 1974 was about 4.6 million tons per year. In the second quarter of 1975, two major expansions are scheduled: An increase of 1.1 million tons per year by Allied Chemical Corp. and 0.8 million tons per year by FMC Corporation, thereby increasing the national total to 6.5 million tons per year. In the third quarter of 1977, two additional increases in capacity are due to come onstream—Kerr McGee's new plant at Searles Lake, Calif., at 1.3 million tons per year, and Texasgulf Inc.'s new plant at Granger, Wyo., at 1.0 million tons per year. When the new plants are in operation, U.S. production capacity for natural soda ash will be 8.5 million tons per year, 85% greater than that of 1974. Stauffer Chemical Co. is said to be planning further increases in capacity, but no formal announcement has been made.

It might have appeared that the industry was building toward overcapacity, but two conditions were likely to keep the supply and demand in balance. First, it was probable that there will be further reductions in Solvay soda ash production because of its unfavorable economics and pollution problems; second, there will probably be an increase in world demand for soda ash and, consequently, an active export trade from the United States.

At the end of 1974, soda ash stocks were quite low, and it was estimated that several months would be required to build inventories back to normal levels.[3]

Some of the natural soda ash plants in Green River, Wyo., were curtailed in their use of natural gas and had to change to fuel oil for processing heat.

There was a 6.6% increase in total U.S. sodium sulfate production in 1974, and most of this increase occurred in manufactured, rather than in natural, salt cake. Naturally derived sodium sulfate sold or used comprised 49% of the total as compared with 51% in 1973. In the past, natural salt cake had shown a growth rate of about 5% per year. Natural sodium sulfate was produced by four companies at six plants located in California, Texas, and Utah.

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[3] Chemical and Engineering News. All Signs Point to a Good Year for Soda Ash. V. 53, No. 8, Feb. 24, 1975, p. 11.

Ozark-Mahoning Co., which operated two salt cake plants in Texas, was purchased by the Pennwalt Corp. Kerr McGee Chemical Corporation, which operated one of the plants at Searles Lake, Calif., purchased its neighbor plant from the Stauffer Chemical Co.[4] Kerr-McGee was in the process of building a new plant on Searles Lake that was scheduled to start producing, among other products, about 400,000 tons per year of sodium sulfate by the end of 1977. Foote Mineral Company of Kings Mountain, N.C., was scheduled to complete a new lithium carbonate plant in 1976 that was designed to produce about 18,000 tons per year of byproduct sodium sulfate.

The FMC Corporation rayon plant at Parkersburg, W.Va., was closed in October 1974 with an attendant loss of 22,000 tons per year of byproduct sodium sulfate.[5]

Metallic sodium production dropped 2% to 173,212 tons in 1974 probably due to decreased demand in the tetraethyl-lead industry where most of the metallic sodium is used. A list of U.S. producers of natural sodium compounds and metallic sodium follows:

Product and company	Plant location	State	Source of sodium
Soda ash:			
Kerr McGee Chemical Corporation	Trona	California	Dry lake brine.
Do	Westend	do	Do.
Allied Chemical Corp	Green River	Wyoming	Underground trona.
FMC Corporation	do	do	Do.
Stauffer Chemical Co	do	do	Do.
Sodium sulfate:			
Kerr-McGee Chemical Corp	Trona	California	Dry lake brine.
Do	Westend	do	Do.
United States Borax & Chemical Corp	Boron	do	Open pit mining.
Ozark-Mahoning Co	Brownfield	Texas	Subterranean brine.
Do	Seagraves	do	Do.
Great Salt Lake Minerals & Chemical Corp.	Ogden	Utah	Salt lake brine.
Metallic sodium:			
E. I. du Pont de Nemours & Co	Niagara Falls	New York	Salt.
Do	Memphis	Tennessee	Do.
Ethyl Corp	Baton Rouge	Louisiana	Do.
Do	Houston	Texas	Do.
Reactive Metals Inc	Ashtabula	Ohio	Do.

CONSUMPTION AND USES

Normally more than half of the U.S. soda ash and about 5% of the sodium sulfate consumption goes to the glass industry, but during the latter part of 1974 there was a slump in ordinary glass production, especially in flat glass for the building industry and for automobile glass. Reduction in these fields was estimated to be at least 35%.[6] Production of glass for containers was also down about 10%, so the demand for soda ash and sodium sulfate in glass was reduced proportionately. Production of pulp and paper was estimated to be reduced 20% in 1974, but the soda ash and sodium sulfate consumption for this end use held up well because of the shortage of caustic soda, which is interchangeable with soda ash in the pulping process.[7]

The soap and detergent industry continued to grow at its customary 4% to 5% per year rate, and it consumed proportionately more soda ash and sodium sulfate. Reduction of phosphates in soap formulations for ecological reasons required the use of more soda ash and sodium sulfate.

Production of chlorine-caustic soda is of significance because of the interchangeability of soda ash and caustic soda. Toward the end of 1974, there was a sharp drop in demand for chlorine because of declines in chlorinated solvents, chemicals, and paper products. This reduced the availability of caustic soda, a coproduct of chlorine production and allowed soda ash to penetrate caustic soda markets.

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[4] Chemical Marketing Reporter. Salt Cake Acquisition Makes Kerr-McGee Largest Producer. V. 206, No. 17, Oct. 21, 1974, p. 26.

[5] Chemical Marketing Reporter. Salt Cake Facility Shuts Down: FMC Calls Unit Uneconomical. V. 206, No. 19, Nov. 4, 1974, p. 23.

[6] Chemical Marketing Reporter. Soda Ash Markets Softening; Makers Expect Future Growth. V. 207, No. 8, Feb. 25, 1975, p. 16.

[7] Work cited in footnote 6.

One developing application for soda ash was the reduction of sulfur pollution in stack gases, primarily in powerplants and other large furnaces. Powdered soda ash was injected with the fuel after which it reacts with sulfur dioxide, or other sulfur-bearing gases, to form solids such as sodium sulfite. These solids may be removed from the exhaust gases by filters or precipitators.

Production of tetraethyl lead and tetramethyl lead required the use of metallic sodium in their manufacture. Demand for antiknock compounds was off 9% in 1974 as compared with a 2% reduction in demand for metallic sodium. From these figures, it might be inferred that losses from the manufacture of antiknock compounds were offset by increases in other applications of metallic sodium such as reduction of metallic ores and in the manufacture of detergents.

PRICES

Average producer prices for soda ash rose by 34% in 1974 from $25.36 per ton in 1973 to $33.87 per ton in 1974. Actual prices, as quoted, were somewhat higher.[8]

Average producer prices for sodium sulfate rose by 39% from $17.26 per ton in 1973 to $23.99 per ton in 1974.

Similar producer prices were not surveyed by the Bureau of Mines for metallic sodium, but prices quoted in the Chemical Marketing Reporter indicated no change in 1974. Market prices quoted at yearend for sodium compounds were as follows:

	1973	1974 [1]
Sodium carbonate (soda ash):[2]		
Light, paper bags, carlots, works ---- per ton --	$49.50	$56.00–$74.00
Light, bulk, carlots, works ---- do ----	35.50	54.00– 64.00
Dense, paper bags, carlots works ---- do ----	49.50	42.00– 42.50
Dense, bulk, carlots, works ---- do ----	35.50	42.00– 54.00
Sodium sulfate (100% Na_2SO_4):		
Technical detergent, rayon-grade, bags, carlots per ton --	43.00– 46.00	43.00– 46.00
Technical detergent, rayon-grade, bulk works do ----	33.00	33.00– 38.00
Domestic salt cake, bulk, works[3] ---- do ----	28.00	31.00
National Formulary (N.F. XII), drums per pound --	.23½	.23½
Metallic sodium:		
Bricks, carlots, works ---- do ----	.30	.30
Fused, lots 18,000 pounds and more, works - do ----	.26½–.27½	.26½–.27½
Bulk, tank, works ---- do ----	.18¾	.18¾

[1] Chemical Marketing Reporter. Current prices of chemicals and related materials. V. 206, No. 27, Dec. 30, 1974.

[2] Soda ash prices for 1973 converted from pounds to tons for comparability.

[3] East of Mississippi River; price in the west is $18.50 per ton, f.o.b. producing point.

FOREIGN TRADE

In 1974, exports of soda ash increased to an alltime high of 7.5% of the total U.S. production or 564,000 tons. Slackened demand in the United States and the worldwide shortage of soda ash provided double impetus for the large export trade. Over half of the export went to North American countries; about one-fourth, to South American countries; and one-fifth, to Asiatic and Oceanic countries. There was a small (0.5%) amount of soda ash imported.

The United States imported 22% of its sodium sulfate supply and exported 3%. About 64% of the imports came from Canada, and nearly all the rest came from Belgium-Luxembourg. About one-fourth of the exports went to Canada and Mexico; 28%, to Australia; and 34%, to Asiatic countries.

The value of exports of sodium compounds exceeded the value of imports by over $23 million.

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[8] Chemical Marketing Reporter. Heavy & Ag Chemicals—Soda Ash. V. 206, No. 22, Nov. 25, 1974, p. 23.

Tariff rates for imported sodium compounds in 1974 are shown in the following tabulation:

	Tariff Jan. 1, 1974 (dollars per short ton)
Sodium carbonate:	
Calcined (soda ash)	2.40
Hydrated and sesquicarbonate	4.00
Sodium sulfate:	
Crude (salt cake)	Free
Anhydrous	.40
Crystallized (Glauber's salt)	.80

Table 3.—U.S. exports of sodium carbonate and sodium sulfate
(Thousand short tons and thousand dollars)

Year	Sodium carbonate		Sodium sulfate	
	Quantity	Value	Quantity	Value
1972	480	18,911	29	926
1973	425	16,064	45	2,049
1974	564	34,156	51	3,250

Table 4.—U.S. imports for consumption of sodium sulfate
(Thousand short tons and thousand dollars)

Year	Crude (salt cake) [1]		Anhydrous		Total [1]	
	Quantity	Value	Quantity	Value	Quantity	Value
1972	226	4,082	73	1,275	299	5,357
1973	240	4,054	80	1,602	320	5,656
1974	277	7,162	98	3,220	375	10,382

[1] Includes Glauber's salt as follows: 1972, 56 tons ($1,491); 1973, 110 tons ($2,200); 1974, 1,270 tons ($29,166).

Table 5.—U.S. imports for consumption of sodium carbonate and bicarbonate in 1974
(Thousand short tons and thousand dollars)

	Quantity	Value
Soda ash	32	3,258
Sodium bicarbonate	3	331
Total	35	3,589

WORLD REVIEW

A perusal of tables 6 and 7, world data on production of soda ash and sodium sulfate, reveals that only 18% of the world's soda ash comes from natural sources, and the United States produced 94% of this quantity. Of the synthetic or Solvay soda ash, East Europe and U.S.S.R. produced 40%; Western European nations, 29% (69% for all Europe); North America, 20%; and Asia, 11%. The five top ranking soda ash producing nations of the world, in order, were as follows: The United States, U.S.S.R., France, West Germany, and Japan. Together they produced 72% of the world's soda ash.

Natural sodium sulfate provided 45% of the world's supply while the byproduct or synthetic salt cake provided 55%. The North American nations produced 72% of the natural sodium sulfate, but European nations supplied 50% of the synthetic product. The five top ranking sodium sulfate producing nations of the world, in order, were as follows: The United States, Canada, U.S.S.R., Japan, and West Germany. Together they produced 73% of the world's sodium sulfate.

Africa.—Outside the United States, the largest deposits of natural soda ash occurred in Africa as a series of alkaline lakes located in Kenya, Sudan, Chad, Botswana, and Tanzania. The Magadi Soda Co., a subsidiary of Imperial Chemical Industries Ltd. (ICI), of the United Kingdom produced about 220,000 tons of soda ash in 1974 from Lake Magadi, Kenya, the reserves of which were estimated to be over 100 million tons. There was also a commercial operation at Dongola in Sudan producing an estimated 50,000 tons per year from a natron deposit. Most of the output from both of these facilities was exported to other African, Asian, and Arabian countries.

The alkali deposits in Tanzania were being investigated by a consortium of Japanese companies considering the possibilities of commercial exploitation.[9]

Brazil.—At present the only soda ash producer in Brazil is Companhia Nacional de Alcalis (Alcanorte) with a plant at Cabo Frio in the State of Rio de Janeiro. The company revealed plans for the construction of a new plant at Macau, Rio Grande de Norte on the Atlantic coast close to an existing solar salt operation. The new plant is scheduled to have a capacity of 200,000 tons of soda ash per year and is due to be on-stream in 1977.[10]

Canada.—Canada was a major world producer of sodium sulfate at about 604,000 tons per year with over 90% of it coming from natural brine lakes in Saskatchewan and Alberta. Seven plants utilized the resources from these Western Provinces, the reserves of which were estimated at 100 millions tons. Canada exported about 30% of its natural sodium sulfate to the United States and consumed about 75% of the remainder in its pulp and paper industry.[11]

China, People's Republic of.—The alkaline deposits in Manchuria, People's Republic of China, were being worked, but nothing has been published regarding their production or potential. The total soda ash production from the People's Republic of China has been estimated at 1.65 million tons per year.[12]

Europe.—Increases in soda ash production capacity are planned at Varna, Bulgaria (additional 800,000 tons per year), and Torrelavega, Spain (additional 340,000 tons per year).[13]

Japan.—Japan was reported to have produced 1,500,000 short tons of synthetic soda ash and 475,000 short tons of byproduct sodium sulfate. The sodium sulfate was produced during the manufacture of rayon.

Mexico.—Mexico had a production capacity of about 200,000 short tons of sodium sulfate per year in 1974 with most of it consumed in the detergent and cellulose industries. A major sodium sulfate plant was located in Laguna del Rey, Coahuila. Soda ash production in Mexico was about 390,000 short tons in 1974.

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[9] Engineering and Mining Journal. Survey of Mine and Plant Expansions—Other Industrial Minerals. V. 176, No. 1, January 1975, p. 88.

[10] Industrial Minerals. Brazil. Alcanorte Soda by 1977. No. 89, February 1975, p. 31.

[11] Killin, A. F. Sodium Sulfate. Ch. in Can. Miner. Yearbook 1974. Dept. of Energy, Mines, and Res., Ottawa, Canada.

[12] Industrial Minerals. Glass Boom Spurs World Expansion of Soda Ash. No. 81, June 1974, p. 60.

[13] Engineering and Mining Journal. Survey of Mine and Plant Expansions—Other Industrial Minerals. V. 176, No. 1, January 1975, p. 88.

Table 6.—Sodium carbonate: World production, by country
(Thousand short tons)

Country[1]	1972	1973	1974[p]
Natural:			
Chad	[e] 7	NA	NA
Kenya	164	217	[e] 220
Sudan[2]	52	[e] 50	[e] 45
United States[3]	3,218	3,722	4,059
Total	3,441	3,989	4,324
Manufactured:			
Belgium[e]	390	430	440
Brazil[e]	130	140	140
Bulgaria	321	[e] 340	[e] 340
Chile[e]	11	11	11
Colombia[e]	22	22	22
Czechoslovakia	133	[e] 138	[e] 140
Denmark	1	1	[e] 1
France	1,573	1,685	1,724
Germany, East	794	860	[e] 880
Germany, West	1,540	1,568	[e] 1,580
Greece	(1)	(4)	--
India	536	517	[e] 540
Italy[e]	733	740	730
Japan	1,433	[e] 1,480	[e] 1,500
Mexico	383	[e] 390	[e] 390
Netherlands[5]	284	283	[e] 330
Norway	22	[e] 28	[e] 28
Pakistan	75	84	[e] 80
Poland	797	799	[e] 820
Portugal	115	128	[e] 150
Romania	733	746	[e] 750
Spain	412	487	[e] 490
Sweden	(1)	(1)	-
U.S.S.R	4,244	4,519	[e] 4,850
United States	[r] 4,305	3,813	3,502
Yugoslavia	129	142	157
Total	19,116	19,351	19,595

[e] Estimate. [p] Preliminary. [r] Revised. NA Not available.

[1] In addition to the countries listed, a number of nations are either known or believed to have produced sodium carbonate, but production is unreported, and available general information is inadequate for the formulation of reliable estimates of output levels. Notable among the producing countries not listed are Australia, Canada, the People's Republic of China, and the United Kingdom.

[2] Production not reported, figures presented are exports.

[3] Sold or used by producers.

[4] Revised to zero.

[5] Production for sale only; excludes output consumed by producers.

Table 7.—Sodium sulfate: World production, by country

(Thousand short tons)

Country[1]	1972	1973	1974[p]
Natural:			
Argentina	[r,e] 33	48	[e] 50
Canada	507	543	604
Chile[2]	5	5	[e] 5
Iran	20	[e] 21	[e] 22
Mexico	141	192	[e] 195
Spain	[r] 112	136	[e] 145
Turkey	33	41	[e] 45
United States[3]	701	672	684
U.S.S.R.[e] [4]	260	290	310
Total	1,812	1,948	2,060
Manufactured:			
Chile[5]	42	[e] 45	[e] 45
France	170	180	[e] 180
Germany, East	205	206	[e] 210
Germany, West	328	322	[e] 320
Greece[e]	7	7	7
Hungary[e]	11	11	11
Italy	116	[e] 110	[e] 110
Japan	454	463	[e] 475
Portugal	50	54	[e] 55
Spain[6]	120	126	[e] 130
United States[7]	626	633	707
U.S.S.R.[e] [4]	200	210	220
Total	2,329	2,367	2,470

[e] Estimate. [p] Preliminary. [r] Revised.

[1] In addition to the countries listed, the People's Republic of China, Poland, Romania, and the United Kingdom are assumed to have produced manufactured sodium sulfate, and other unlisted countries may have produced this commodity, but production figures are not reported, and available general information is inadequate for the formulation of reliable estimates of output levels.

[2] Natural mine output, excluding byproduct output from the nitrate industry, which is reported under "Manufactured."

[3] Sold or used by producers.

[4] Conjectural estimates based on 1968 information on natural sodium sulfate only.

[5] Byproduct of nitrate industry.

[6] Quantities of manufactured sodium sulfate credited to Spain are reported in official sources in such a way as to indicate that they are in addition to the quantities reported as mined (reported in this table under "Natural") but some duplication may exist.

[7] Derived approximate figure; difference between reported total sodium sulfate production (natural and manufactured, undifferentiated) and reported quantity of natural sodium sulfate sold or used by producers.

TECHNOLOGY

A survey of energy requirements for production of sodium compounds was made in 1974. Average data for production of natural compounds are as follows: Soda ash from trona, 2,100 kilowatt-hours per ton; sodium sulfate from brine, 1,320 kilowatt-hours per ton.

Stone

By Harold J. Drake [1]

Total production of stone, dimension and crushed, decreased 2% from the 1.1-billion-ton output of 1973. Total value, however, increased 10% to a new high of $2.2 billion. Output of dimension stone, at 1.9 million tons valued at $100.3 million, was up 21% in quantity and 17% in value. Output of crushed stone declined 2% in quantity but rose 10% in value to 1.04 billion tons valued at $2.1 billion. Crushed stone accounted for nearly 100% of the quantity and 95% of the value of the stone production.

Production of dimension granite declined 8%, that of limestone and dolomite increased 40%, and that of sandstone, quartz, and quartzite declined 12%. Production of marble gained 52%, whereas slate recorded a decline of 10%. The principal types of crushed stone recorded both increases and decreases in production during the year. Production increases were reported for traprock, 15%, and sandstone, quartz, and quartzite, 2%. Limestone and dolomite decreased 3%, granite 2%, and shell, 8%.

Consumption of crushed stone in major end uses also showed mixed results during the year. Crushed stone used for calcium and lime decreased 5% and 10%, respectively; uses as flux stone and in agriculture increased 10% and 24%, respectively. The use of crushed stone in the remaining major end use, the manufacture of portland cement, was essentially unchanged.

Domestic producers of crushed stone, experiencing higher operating costs in 1974, reluctantly increased prices. The average unit value for crushed stone, f.o.b. quarry, rose $0.20 to $2 per ton. The average unit value for dimension stone declined $1.97 to $52.39 per ton. Exports of dimension stone rose sharply but still represented only a small part of domestic production. Imports of dimension stone rose 4% in value. Exports of crushed stone increased 11% in quantity and 23% in value.

Table 1.—Salient stone statistics in the United States [1]

(Thousand short tons and thousand dollars)

	1970	1971	1972	1973	1974
Shipped or used by producers:					
Dimension stone	1,565	1,626	1,490	1,582	1,915
Value	$95,157	$93,132	$90,763	$85,999	$100,318
Crushed stone	867,628	874,497	918,933	1,058,541	1,041,627
Value	$1,374,441	$1,500,933	$1,581,530	$1,904,464	$2,085,837
Total stone	869,193	876,123	920,423	[2] 1,060,124	1,043,542
Value	$1,469,598	$1,594,065	$1,672,293	$1,990,463	$2,186,155
Exports (value)	$10,396	$11,489	$11,107	$13,063	$18,159
Imports for consumption (value)	$35,674	$33,643	$43,486	$48,678	$51,631

[1] Includes slate.

[2] Data do not add to totals shown because of independent rounding.

Legislation and Government Programs.—The U.S. International Trade Commission (formerly the U.S. Tariff Commission) instituted two investigations under section 301(c)(2) of the Trade Expansion Act of 1962 to determine whether, as a result in major part of concessions granted under trade agreements, articles like or directly competitive with manufactured granite are being imported into the United States in such increased quantities as to cause, or threaten to cause, the unemployment or underemployment of a significant number or proportion of the workers of two firms. The two firms, Joseph Weiss & Sons, Inc., Brooklyn, N.Y., and Johns Swenson Granite Co., Concord, N.H., filed separate petitions on behalf of their workers and former workers. "Investigations were continuing at yearend."

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[1] Physical scientist, Division of Nonmetallic Minerals.

DIMENSION STONE

DOMESTIC PRODUCTION

Of the total quantity of dimension stone sold or used in 1974, granite accounted for 34%; limestone and dolomite, 27%; sandstone, quartz, and quartzite, 14%; slate, 4%; marble, 4%; and other stone, 17%. Output of dimension stone totaled 1.9 million tons valued at $100.3 million. Production of granite totaled 657,758 tons valued at $51.4 million, a tonnage level 8% below that of the preceding year. Limestone and dolomite were up 40% in tonnage to 516,621 tons valued at $18.2 million. Sandstone, quartz, and quartzite declined 12% to 260,936 tons valued at $8.7 million. Slate production declined 10% to 78,690 tons valued at $8.2 million. Marble production rose 52% to 73,455 tons valued at $11.7 million. Dimension stone was produced in 44 States, of which Georgia, Indiana, Ohio, Pennsylvania, and Vermont accounted for about half of the output.

CONSUMPTION AND USES

Apparent consumption of dimension stone, in terms of value, rose 12% to $140.0 million; however, tonnage was believed to have declined in 1974. The share of the market supplied by U.S. producers rose from 69% in 1973 to 72% in 1974.

The value of dimension granite consumed in 1974 rose 11% to $60.7 million. The value of the limestone and dolomite used rose 48% to $16.9 million while that of sandstone, quartz, and quartzite was $9.4 million. Consumption of marble was valued at $31.1 million with approximately 62% of the value represented by foreign marble.

Consumption of domestically produced rough dimension stone totaled 1.3 million tons valued at $32.7 million compared with 960,000 tons valued at $24.5 million in 1973. Use of domestically produced dressed stone was up 4% to 640,000 tons valued at $67.7 million. Cut stone, sawed stone, monumental stone, and house stone veneer accounted for much of the dressed stone, and each recorded gains in 1974. Consumption of cut stone totaled 129,000 tons valued at $21 million, sawed stone, 125,000 tons valued at $7.2 million, monumental stone, 47,000 tons valued at $16.5 million, and veneer, 94,000 tons valued at $4.6 million.

PRICES

Average values for dimension stone in 1974, as reported to the Bureau of Mines, were as follows, in dollars per ton:

	Building		Monumental, rough, dressed	Flagging, dressed
	Rough	Dressed		
Granite	$41.41	$147.35	$83.48	--
Marble	83.61	294.09	--	--
Limestone	17.44	59.36	--	$28.45
Sandstone	23.85	47.26	--	40.67
Slate	--	104.50	--	43.81
Miscellaneous	4.82	69.00	--	--

FOREIGN TRADE

U.S. exports of dimension stone were valued at $5.6 million in 1974 compared with $2.8 million in 1973. Most of the increased value for foreign shipments was accounted for by building and monumental dolomite and other processed stone. Canada, the United Kingdom, and Italy were the principal recipients.

U.S. imports of dimension stone rose 4% in value to $43.2 million. Marble, breccia, and onyx accounted for 45% of the value of imports, granite 22%, slate 18%, and travertine 8%. The remainder consisted of limestone, and undifferentiated stone. Imports of marble were up 5%, granite 8%, and slate 18% in value. Imports of marble slabs and paving tiles, the most important import item, decreased 5% in quantity, but increased 10% in value. Dressed travertine declined 21% in quantity but only 2% in value. Rough and dressed granite declined 39% in quantity and 26% in value.

The principal sources of most of the imported dimension stone were Italy and Portugal who supplied most of the marble and travertine and, along with Spain and the United Kingdom, most of the slate. Italy and Canada supplied most of the granite; the remainder was accounted for by numerous other countries.

TECHNOLOGY

A report to the National Science Foundation by Martin Marietta Corp., Baltimore, Md., and the National Crushed Stone Association, Washington, D.C., detailed the results of a study to determine the possibility of applying sophisticated space industry technology to the crushed stone industry.[2] The comprehensive study stated that the major technical challenges to the crushed stone industry were efficient blasting without detrimental effects, maximum utilization of products and resources, and improved equipment wear and maintenance. The study concluded that no mechanism currently existed for directly translating research results into innovations of practical value to quarry operators and suggested that this problem needed further study.

A new method for grinding stone and concrete using coated abrasive belts and high-horsepower, high-speed grinders was described.[3] The new method utilizes high speeds and dry-grinding conditions and may be of particular use to producers of concrete block. The use of diamond tools for stoneworking was reported in a number of studies. One report dealt with the development of a method and a tool for wire sawing hard stones with bonded abrasives.[4] Rock drilling and stone machining with diamond tools were discussed.[5] The use of diamond tools in all phases of stone processing was extensively covered.[6]

CRUSHED STONE

DOMESTIC PRODUCTION

Crushed stone production declined 2% in quantity but rose 10% in value to 1.04 billion tons valued at $2.1 billion. The decline in quantity was partly offset by the increased coverage of domestic producers. Production of limestone and dolomite declined 3% in quantity but rose 8% in value. Granite production declined 2% in quantity and increased 10% in value. Together, these two kinds of crushed stone accounted for 84% of the total quantity and 80% of the total value of crushed stone in 1974. Output of traprock rose 15% in quantity and 23% in value to 96.9 million tons valued at $217.9 million. Production of sandstone, quartz, and quartzite was up 2% to 31.1 million tons valued $77.8 million. Output of crushed shell declined 8% to 18.2 million tons valued at $43.6 million, and crushed marble output fell 17% to 1.7 million tons valued at $30.6 million.

Crushed stone was produced in every State except Delaware. Pennsylvania produced the most crushed stone, followed closely by Illinois, Texas, Florida, and Ohio, in that order. Limestone and dolomite were produced in 46 States led by Illinois, Pennsylvania, Texas, Florida, Ohio and Missouri. States leading in production of granite were Georgia, North Carolina, Virginia, and South Carolina. Traprock was produced primarily in Oregon, Washington, New Jersey, Connecticut, Massachusetts, and California. Sandstone, quartz, and quartzite were produced mainly in Pennsylvania, Arkansas, and California. Shell was produced almost entirely in Louisiana and Texas. Other kinds of stone were produced in many different States but mainly in California, Pennsylvania, Alaska and New Mexico.

Domestic producers were faced with numerous operating problems in addition to inflation, recession, and the energy crisis. Concern rose for protecting the environment from air, water, and noise pollution derived from quarrying operations. The principal problems were suppressing dust and treating process water, both of which were costly. Many producers found that zoning ordinances were being enacted that seriously reduced their stone resources and threatened their future operations.[7] Labor costs continued to rise but they appear to have been offset by increased productivity. Maintenance cost of heavy equipment, particularly crushers, rose rapidly in 1974.

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[2] Ozol, M. A., S. A. Locke, J. Gray, R. E. Jackson, and A. Preis. A Study to Determine the Feasibility of an Experiment to Transfer Technology to the Crushed Stone Industry. Martin Marietta Lab., MML TR-74-26c, June 1974, 94 pp.

[3] Lokken, R. C., W. J. McDonald, and E. J. Duwell. Grinding Stone and Concrete With Coated Abrasives. Ceram. Bull., v. 53, No. 9, Aug. 28, 1973. pp. 646-649.

[4] Tonshoft, H. K., and H. J. Panhorst. Development and Testing of a Diamond Wire for the Sawing of Hard Stone. Ind. Diamond Rev., July 1974, pp. 246-251.

[5] Norling, R. G. Rock Drilling With Diamond. DeBeers Ind. Diamond Div., Diamond Inf. L 19, 6 pp.

DeBeers Industrial Diamond Division. Machining Stone With Diamond Tools. Diamond Inf. L 15, 9 pp.

[6] DeBeers Industrial Diamond Division. Diamonds in Industry. Stone. 67 pp.

The increased demand anticipated for the future has led to the erection of new plants and the modernization and expansion of others. Aggregate producers were advised to develop their managerial skills regarding capital investment programs.[8] Florida Rock Industries, Inc., Jacksonville, Fla., built a new plant at Fort Myers, Fla., with an hourly capacity of 350 tons which, by careful design, can be doubled by the addition of a few major pieces of equipment.[9] Georgia Marble Co. placed into operation a new crushed stone plant at Douglasville Ga.[10] Operated by Consolidated Quarries Division of the company, the plant is semimobile and can be expanded to 800 tons per hour. In order to supply crushed stone for the Gathright Lake Project in the George Washington National Forest, the Jarfo Co. of Salem, Va., erected a crushed stone plant that will be converted to a roadstone operation when the dam is completed.[11] Leesburg Stone Co., Leesburg, Va., demolished its old 150-ton-per-hour crushing plant near Leesburg and erected in its place an 800-ton-per-hour plant more capable of supplying expanding markets in Virginia and Washington, D.C.[12] The annual capacity of the new plant is 1.5 million tons, which can easily be increased to 2.5 million tons by adding a large-size tertiary crusher. Concern for the environment and neighborhood relations led New Haven Trap Rock/Tomasso, North Branford, Conn., to embark on a program of modernization to improve plant performance and to develop an effective environmental protection program.[13] After pollution control measures were put into effect, an open house was held to acquaint local residents with the work being done in the quarry and the measures undertaken by the company to control pollution. Prior to building its new crushed granite plant at Columbus, Ga., LBI Quarries, Inc., Rome, Ga., designed the operation to conform to all antipollution standards.[14] The Environmental Protection Division, Georgia Department of Natural Resources, directed the company to submit a reclamation and conservation plan for approval before beginning operations and for each year thereafter.

The versatility and usefulness of portable crushing and screening plants were described in detail.[15] Lecanto Corp., Lecanto, Fla., in its hard limestone quarry used tire-mounted screens, crushers, and conveyors.[16] The advantages of mobility included the ability to follow the quarry face and to easily change the equipment whenever necessary to produce a different product mix. Two portable screening and crushing plants were used by Bruening Rock Products Co., Decorah, Iowa, to service 26 quarries.[17] Consolidated Quarries Div., Georgia Marble Co., Litonia, Ga., used a semiportable plant to sharply increase productive capacity and to manufacture a wider range of aggregate sizes.[18] Semiportable equipment was used for similar purposes by Hoover, Inc., Loganville, Ga.[19] The equipment reportedly delivers a wide variety of products, has increased productivity, and can be quickly changed to meet changed customer specifications. In addition, Hoover, Inc., used semiportable crushing and screen equipment to custom-crush granite for other mineral companies in the area.[20] Colorado Lien Co., Fort Collins, Colo., used a new portable crushing plant in conjunction with an expanded fine-grinding plant to sharply increase its capability of supplying its market area.[21] The company also installed dust collection equipment in its fine-grinding plant. Portability was a prime concern of Becker Sand and Gravel Co., Cheraw, S.C., when it erected its new crushed granite plant near Jefferson, S.C.[22] Each of the plant's four processing sections were designed for a high degree of flexibility in arrangement in order to rapidly adjust to changing product demand.

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[7] Edgerton, C. D. Effects of Urbanization Upon the Availability of Construction Minerals in Southeastern Florida. BuMines IC 8664, 1974, 20 pp.

[8] Schultz, G. A. Managerial Investment in Aggregate Plant Expansion. Rock Products, v. 77, No. 12, 1974, pp. 55–56.

[9] Traueffer, W. E. Florida Rock's New 350-tph Fort Myers Crushed Stone Plant. Pit & Quarry, v. 66, No. 8, 1974, pp. 60–65.

[10] Trauffer, W. E. Consolidate's New 500-tph Crushed Granite Plant. Pit & Quarry, v. 66, No. 12, 1974, pp. 60–66, 104.

[11] Pit & Quarry. New Virginia Plant Supplying Dam Project. V. 67, No. 3, 1974, pp. 112–113.

[12] Robertson, J. L. Newest Luck Quarries Plant Rated at 1½ Million TPY. Rock Products, v. 77, No. 10, 1974, pp. 41–44.

[13] Robertson, J. L. Modernization Program Coordinates Environmental & Functional Planning. Rock Products, v. 77, No. 11, 1974, pp. 42–47.

[14] Trauffer. W. E. LBI Quarries, Inc. Expands To Meet Growing Demand. Pit & Quarry, v. 66, No. 8. 1974. pp. 80–82. 86.

[15] Rundquist. W. A. The Portable Plant . . . A Versatile. Hard-Working Tool. Pit & Quarry, v. 67, No. 2. 1974. pp. 86–88. 91–94.

[16] Roads & Streets. Portables Solve Problems of Aggregates Production. V. 117, No. 9, 1974, pp. 93–94.

[17] Robertson, J. L. Portable Set-Ups Service 26 Quarries. Rock Products, v. 77, No. 9, 1974, pp. 48–49, 98.

[18] Robertson, J. L. Consolidated Quarries Boosts Capacity of 75 Percent. Rock Products, v. 77, No. 9, 1974, pp. 55–58.

[19] Roads & Streets. Semi-Portable System Delivers 6,000 tpd of Granite Aggregates. V. 117, No. 9, 1974, pp. 28–29.

CONSUMPTION AND USES

Apparent consumption in 1974 was equivalent to production inasmuch as imports and exports were about equal. Consumption was valued at $2.1 billion. The total 1.04 billion ton production comprised 72% limestone and dolomite, 11% granite, 9% traprock, 3% sandstone, quartz and quartzite, 2% shell, and 3% other kinds of crushed stone. Compared with 1973, consumption of limestone and dolomite was off 3% in quantity to 752 million tons valued at $1.4 billion. Crushed granite was down 2% to 118.6 million tons valued at $238.1 million, and traprock valued at $217.9 million, rose 15% to 96.9 million tons. Arenaceous stone, such as sandstone, was up 2% in quantity to 31.1 million tons valued at $77.8 million.

Construction aggregate continued to be the major use for crushed stone. In 1974, this use accounted for 68% of the total and amounted to 709.4 million tons valued at $1.4 billion. The three principal components of this type of use were dense-graded roadbase stone (off 6% to 245.6 million tons valued at $440.4 million), coarse concrete aggregate (off 11% to 139.3 million tons valued at $276.6 million), and unspecified construction aggregate (off 2% to 128.9 million tons valued at $264.0 million). Consumption of bituminous aggregate, another major construction use, was essentially unchanged at 102.8 million tons valued at $226 million. The main nonconstruction uses were agricultural stone (up 24%), cement manufacture (unchanged), lime manufacture (down 5%), and flux stone (up 10%).

PRICES

Quotations in Engineering News-Record for carload lots of ¾-inch and 1-½-inch crushed stone in 1974, exclusive of discounts, ranged from $6.75 per ton in Minneapolis to $1.75 per ton in Birmingham. The average price of ¾-inch crushed stone was $4.30 and that of 1-½-inch stone was $4.24 for 17 major cities. Prices per ton for industrial fillers and extenders, as reported in the American Paint Journal, were as follows, in dollars:

Silica, amorphous, ultrafine-ground	69.00
Silica, crystalline	20.50– 45.40
Whiting, precipitated surface-treated	48.00
Whiting, dry-ground, 325 mesh	16.00– 38.00
Whiting, precipitated, U.S.P	50.00–117.00
Whiting, precipitated, technical	33.00– 44.00
Whiting, natural, water-ground	34.00– 54.00

FOREIGN TRADE

Exports of crushed and broken stone totaled 3.4 million tons valued at $12.6 million. Exports increased 11% in quantity and 23% in value over the levels of the preceding year. Exports of crushed stone consisted almost entirely of granite, limestone, and other calcareous stone. The major increase in exports was accounted for by fluxing limestone, which accounted for 80% of all exports. As in past years, Canada was the principal market for exported crushed stone.

Imports of crushed stone totaled 3.5 million tons valued at $5.7 million and were about equally divided between limestone and other kinds of stone. In terms of quantity, imports were up 8%; in terms of value, up 14%. Canada was the principal source of crushed stone imports.

Imports of dry, ground whiting rose 28% in quantity and 87% in value to 34,181 tons valued at $1.6 million. Imports of precipitated chalk whiting were about the same as in 1973, but with a 36% increase in value.

WORLD REVIEW

Canada.—Production of limestone on Texada Island, British Columbia, is used principally in the manufacture of cement and lime. Four companies operated quarries on Texada and barged much of the output to Vancouver, British Columbia, and Washington State. Barge capacities ranged up to 20,000 tons and distances traveled up to 400 miles.

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[20] Robertson, J. L. Semi-Portable Custom Crushers for Atlanta Market. Rock Products, v. 77, No. 9, 1974, pp. 50–52, 100.

[21] Trauffer, W. E. Colorado Lien's Fort Collins Plants. Pit & Quarry, v. 67, No. 7, 1975, pp. 94–97.

[22] Trauffer, W. E. Becker's New 250-tph Crushed Granite Plant. Pit & Quarry, v. 66, No. 11, 1974, pp. 64–66, 82, 92–93.

Panama.—The new crushed stone plant of Cantera Le Esmeralda, Ojo De Agua, Panama, reportedly was one of the most efficient and flexible operations in the Western hemisphere.[33] The company has begun producing specification material in large quantities, which should not only make the operation profitable, but also provide strong competition for other producers.

South Africa, Republic of.—Hippo Quarries Div., Hippo Holding Co. Ltd., operated an andesite quarry about 8 miles south of Johannesburg.[34] Output consists mainly of aggregate stone for building and road construction and top-quality crushed concrete sand. Stone reserves are sufficient for 50 years of production.

Sweden.—A. B. Mataki's stone quarry and crushing plant at Södra Sandby in southern Sweden has become a center of attraction because of its unusual layout and dust-free operation.[35] Swedish authorities stipulated that the operation of the quarry could continue only if it was absolutely dust-free. To achieve this requirement, the entire process line was completely sealed with openings only for stone feed and products delivery. A small vacuum is maintained within the line to insure that no dust escapes through the openings. Environmental safety is high and the noise level is low.

Other companies featuring dust-free operating conditions are Goteborgs Makadam A. B. at Göteborg on the west coast[36] and Armerad Betong near Listarum in the southern part of Sweden.[37] The Betong plant was the first erected since Sweden enacted laws requiring all rock-processing machinery to be closed.

United Kingdom.—Stavely Lime Products, Ltd., brought onstream a new crushing plant at its Doves Hole Quarry.[38] The plant, which replaced two other smaller plants, was needed not only to supply the expected increased long-term demand, but also to insure that current and future production could be achieved with maximum flexibility and economy. Tarmac Roadstone Holdings Ltd. continued exploitation of its gritstone-graywacke quarry near Shrewburg, Shropshire.[39] The company erected a new plant complete with extensive dust-control equipment and numerous trees to reduce the visual impact of the plant from local residents. Amey Roadstone Corporation Ltd., Britain's biggest producer of construction aggregates, uses a fleet of mobile diamond drilling rigs to evaluate the quality and quantity of its stone reserves. Using special coring equipment, the company, which normally produces over 33 million tons of aggregates per year, has improved its field efficiency and reduced its drilling costs.

TECHNOLOGY

Concern for the environment continued at a high level. The Federal Bureau of Mines published a study on dust control at crushed stone operations.[40] The study reported on the cost and efficiency of the fabric filter method, the wet suppression method, and a combination of the two methods. The three systems were being used by quarry operators. A fabric-type dust collection system was described.[41] The system is completely automatic and has the additional feature of modular construction, which easily permits increased capacity in the future by the addition of more modules. U.S. Lime Div. of The Flintkote Co., developed an effective dust control system at its Apex, Nev., stone quarry.[42] The company installed a water spray-wetting agent system at its crushing plant that was practically 100% effective, with the added benefits of cleaner working conditions and higher employee morale.

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[33] Pit & Quarry. New 200-tph Panama Aggregates Plant Displays Efficiency, Flexibility. V. 67, No. 3, 1974, pp. 110–111.

[34] Holz, P. A New 3,000 CMPO Crushed Stone Plant in South Africa. Pit & Quarry, v. 67, No. 7, 1975, pp. 115–118.

[35] Asklof, S. New System of Quarry Plant Dust Control. Quarry Managers J., v. 58, No. 1, 1974, pp. 24–27.

[36] Quarry Managers Journal. A Modern Swedish Granite Quarry Operation. V. 58, No. 2, 1974, pp. 37–42.

[37] Ironman, R. Swedes Legislate Total Plant Enclosures. Rock Products, v. 77, No. 4, 1974, pp. 54–55.

[38] Quarry Management and Products. A Major New Derbyshire Limestone Plant. V. 1, No. 6, 1974, pp. 197–206.

[39] Quarry Managers Journal. Major Development of a Gritstone Quarry. V. 58, No. 5, 1974, pp. 131–136.

[40] Evans, R. J. Methods and Costs of Dust Control in Stone Crushing Operations. BuMines IC 8669, 1975, 21 pp.

[41] Pit & Quarry. Dust Collection at the Balf Company's Newington, Conn. Plant. V. 67, No. 7, 1975, pp. 99–100.

[42] Krohn, D. J. Project at Apex, Nev., Operation Runs Gamut From Locating Water Source to Kiln Baghouse Installations. Pit & Quarry, v. 66, No. 11, 1974, pp. 87–92.

Automatic data processing was used in various ways by the crushed stone industry. One company used it to increase productivity by reducing manpower requirements.[33] Another company used the technique to monitor truck service and maintenance work in order to increase effective truck life.[34] Results of the program indicate that the optimum operating life of the equipment has been doubled. The height of the haul trucks is important in underground crushed stone mines. One company used 22-ton trucks with a loading height of 81 inches and equipped with articulated steering to haul rock to the primary crusher.[35] A significant study of cost-saving management techniques related to tires for off-highway equipment was conducted.[36] Production increases of 20% were obtained by the installation of air tools and positioning booms to reduce oversize and keep material flowing through the primary crusher.[37]

Quarry operators were provided with information regarding the effects of jointing and bedding on rock fragmentation when bench blasting.[38] The study also provided information on the use of inexpensive equipment and field techniques for mapping joints and bedding planes within the quarry. Recent results of studies on the sensitivity of various experimental explosive systems using ammonium nitrate as the oxidizing agent were published.[39] The safe use of fertilizer-grade ammonium nitrate as a blasting agent in crushed stone quarries was discussed.[40] The study reported on the physical properties, uses, hazards, and correct safety precautions. Water in quarry drill holes plagues operators. To overcome this problem, water gel cartridges were used.[41] When waterproof bags of ammonium nitrate proved unsatisfactory, dynamite or water gel was substituted. The final selection of the gel as the blasting agent was based on a higher degree of safety and preference by the workers in the quarry. On the other hand, dewatering of some blastholes is not only practical but there are economic benefits to be gained.[42]

Two potential markets were reported for stone. Wet-scrubbing of electric utility stack gases using lime, limestone, and other carbonate materials was discussed,[43] as was the basalt to form fibers for use as construction materials.[44]

The use of limestone to remove sulfur oxides from stack gases of electricity-generating plants was discussed.[45] If environmental pressure against open pit operations becomes too severe, it may become necessary to go underground for aggregate materials. Converting an open pit operation to an underground mine and the advantages in doing so were discussed.[46] Recycling waste aggregate products was a source of income for aggregate producers.[47]

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[33] Robertson, J. L. El Paso Rock Quarries Automates Crushed Stone Production. Rock Products, v. 77, No. 10, 1974, pp. 51–54.

[34] Rock Products. Arizona Firm Attacks Fleet Maintenance From Many Angles. V. 77, No. 11, 1974, pp. 60, 62.

[35] Rock Products. Kansas Limestone Mine Uses Low Height Haul Trucks. V. 77, No. 9, 1974, pp. 70–71.

[36] Roads & Streets. Tire Costs Can be Cut. V. 117, No. 7, 1974, pp. 60–63, 68–70.

[37] Pit & Quarry. Crusher Downtime Reduced by Air Tool Installations. V. 67, No. 2, 1974, pp. 105–107.

[38] Larson, W. C. and J. M. Pugliese. Effects of Jointing and Bedding Separation on Limestone Breakage at a Reduced Scale. BuMines RI 7863, 1974, 13 pp.

[39] Watson, R. W., J. E. Hay, and K. R. Becker. Sensitivity of Some Ammonium Nitrate-Based Explosive Compositions. BuMines RI 7840, 1974, 8 pp.

[40] Pit & Quarry. ANFO Mixtures as Blasting Agents. V. 67, No. 3, 1974, pp. 80–83.

[41] Roads & Streets. Water Gel Cartridges Defeat Water in Blastholes. V. 118, No. 1, 1975, p. 123

[42] Dannenberg, J. Blasthole Dewatering. Pit & Quarry, v. 66, No 12, 1974, pp. 79–80.

[43] Malhotra, R., and R. L. Major. Electric Utility Plant Flue-Gas Desulfurization. Ill. State Geol. Survey, Ill. Miner. Note 57, June 1974, 19 pp.

[44] Raff, R.A.V. Mineral Fiber From Basalt-Potential New Industry. E&MJ, v. 175, No. 2, 1974, pp. 76–78.

[45] Cline, L. D. Limestone & Pollution-Solution. Limestone, v. 11, No. 40, 1974, pp. 20, 48–51.

[46] Augenbaugh, N. B., C. R. Christiansen, and J. J. Scott. Conversion From Quarrying to Underground. Rock Products, v. 77, No. 9, 1974, pp. 61–65.

[47] Ferdon, R. E. Turn Screenings Into Profits. Rock Products, v. 77, No. 9, 1974, pp. 74–75.

Roads & Streets. Old Asphalt Can Be Valuable Raw Material. V. 17, No. 6, 1974, pp. 105–106.

Table 2.—Stone shipped or used by producers in the United States, by State

(Thousand short tons and thousand dollars)

State	1973		1974	
	Quantity	Value	Quantity	Value
Alabama [1]	20,043	40,117	23,773	60,231
Alaska	5,967	12,741	5,485	12,947
Arizona	4,265	9,469	4,932	11,479
Arkansas	16,223	26,209	20,381	38,905
California	43,838	77,175	45,709	91,891
Colorado	6,357	14,003	6,572	15,109
Connecticut	9,682	21,305	8,457	21,134
Florida [1]	61,735	103,595	54,560	100,378
Georgia	40,841	97,506	40,321	105,582
Hawaii	7,180	18,466	7,638	21,370
Idaho	2,972	8,096	3,528	9,868
Illinois	66,653	114,068	63,231	121,763
Indiana [1]	32,288	57,652	31,031	64,106
Iowa	31,541	56,918	32,343	66,119
Kansas	[1] 18,334	[1] 33,601	[1] 17,869	34,869
Kentucky	[1] 38.205	[1] 70,912	34,542	66,632
Louisiana [1]	10,802	21,309	10,940	24,046
Maine	1,212	3,329	1,491	4,255
Maryland	18,585	46,732	18,072	47,630
Massachusetts	8,580	28,738	8,103	30,103
Michigan	45,886	60,494	47,479	72,748
Minnesota	7,581	20,411	8,301	22,041
Mississippi	[1] 760	[1] 809	1,720	2,572
Missouri	49,304	79,921	50,626	90,204
Montana	5,054	9,559	[1] 3,115	[1] 6,242
Nebraska	5,368	10,958	4,630	10,364
Nevada	3,595	5,429	2,186	4,203
New Hampshire	1,836	5,416	590	5,371
New Jersey [1]	15,902	45,585	15,749	52,456
New Mexico	2,830	5,894	[1] 3,531	8,359
New York	44,393	94,693	38,207	87,724
North Carolina	38,782	80,065	34,762	75,142
North Dakota	W	W	35	115
Ohio [1]	55,107	98,009	51,709	105,098
Oklahoma	22,316	34,999	22.228	36,599
Oregon	13,411	21,843	23,353	43,406
Pennsylvania	78,564	150,846	78,092	159,615
Rhode Island	W	W	429	1,375
South Carolina	14,985	24,280	[1] 12,242	[1] 21,719
South Dakota	2,745	11,607	2,968	14,231
Tennessee	42,742	71,116	41,720	75,547
Texas [1]	62,574	91,879	63,074	109,758
Utah	2,848	6,318	2,869	6,410
Vermont	1,871	19,523	1,932	21,630
Virginia	43,895	82,719	44,176	95,988
Washington	11,384	19,284	15,095	24,483
West Virginia	11,732	22,821	10,954	22,308
Wisconsin	23,818	36,917	22,443	40,912
Wyoming	3,191	6,716	2,384	[1] 5,989
Undistributed [1]	2,345	11,412	2,963	15,128
Total [2]	1,060,124	1,990,463	1,043,542	2,186,155
Pacific Island Possessions	1,309	3,292	848	1,566
Puerto Rico	15,647	41,857	14,362	41,640
Virgin Islands	664	2,860	638	3,869

W Withheld to avoid disclosing individual company confidential data; included with "Undistributed."

[1] To avoid disclosing individual company data, certain State totals are incomplete; the portion not included has been combined with "Undistributed." The class of stone omitted from such State totals is noted in the summary chapter of this volume.

[2] Data may not add to totals shown because of independent rounding.

Table 3.—Stone shipped or used by producers in the United States, by kind

(Thousand short tons and thousand dollars)

Year	Granite		Traprock[1]		Marble		Limestone and dolomite		Shell	
	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value
1970 -----	86,709	183,312	77,227	146,661	1,785	33,734	625,796	961,018	21,718	31,035
1971 -----	93,486	194,715	75,318	160,582	1,717	34,860	628,503	1,031,211	18,537	30,088
1972 -----	106,887	225,571	77,044	159,934	2,318	41.545	671,907	1,105.085	16,610	29,571
1973 -----	121,320	262,834	83,962	177,703	2,071	33.532	774,767	1,333.855	19,896	37,650
1974 -----	119,216	289,545	96,886	217,926	1,758	42,287	752,031	1,446,388	18,235	43,626
	Calcareous marl		Sandstone, quartz, and quartzite		Slate		Other stone[2]		Total[3]	
1970 -----	1,739	1,554	24,059	59,185	1,241	13,367	28,925	39,738	869,193	1,469,598
1971 -----	3,459	4,504	30,729	84,630	1,232	13,615	23,143	39,860	876,123	1,594,065
1972 -----	2,650	3,598	27,047	65,678	1,595	14,925	14.364	26,386	920.423	1,672,293
1973 -----	2.327	3.042	30,647	78,084	1,555	15,980	23,580	47,785	1,060,124	1,990,463
1974 -----	3,889	5,956	31,351	86,508	1,454	17,120	18,727	36,804	1,048,542	2,186,155

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[1] Includes gabbro, basalt, diabase, etc.

[2] Includes mica schist, conglomerate, argillite, various light-colored volcanic rocks, serpentine not used as marble, soapstone sold as dimension stone, etc.

[3] Data may not add to totals shown because of independent rounding.

Table 4.—Dimension stone shipped or used by producers in the United States, by use and kind of stone

(Thousands)

Kind of stone and use	1973 Short tons	1973 Cubic feet	1973 Value	1974 Short tons	1974 Cubic feet	1974 Value
GRANITE						
Rough:						
Architectural	49	533	$2,030	47	484	$1,550
Construction [1]	113	1,236	912	89	1,044	855
Monumental	312	3,227	12,260	293	3,033	15,336
Flagging [2]	1	12	54	1	15	63
Dressed:						
Cut	36	432	11,323	34	413	11,370
Sawed	25	293	1,490	27	315	1,455
House stone veneer	5	63	153	2	21	75
Construction	4	54	371	4	53	553
Monumental	30	360	9,525	34	388	11,962
Curbing	136	1,610	7,688	121	1,445	7,844
Other dressed stone [3]	1	15	154	6	75	337
Total [4]	713	7,834	45,960	658	7,256	51,401
LIMESTONE AND DOLOMITE						
Rough:						
Architectural	139	1,872	3,040	206	2,775	4,272
Construction [1]	66	827	931	99	1,157	1,165
Flagging	14	179	248	16	198	283
Unspecified rough stone	2	20	14	2	21	14
Dressed:						
Cut	44	598	4,156	52	681	5,673
Sawed	32	433	1,369	65	877	3,832
House stone veneer	60	778	1,858	63	825	2,580
Construction	11	136	259	11	139	239
Flagging [5]	2	23	43	2	26	94
Unspecified dressed stone	(6)	(6)	5	--	--	--
Total [4]	370	4,866	11,923	517	6,699	18,150
MARBLE						
Rough:						
Architectural	5	56	344	34	371	3.560
Construction [1]	9	106	214	13	152	359
Other rough stone [7]	(6)	2	2	W	W	W
Dressed:						
Cut	13	152	3,653	9	104	1,962
Sawed	3	33	484	1	12	269
House stone veneer	2	29	698	W	W	W
Construction	W	W	W	W	W	W
Monumental	15	175	4,633	W	W	W
Other dressed stone [8]	(6)	5	110	17	192	5,582
Total [4]	48	557	10,137	73	832	11,733
SANDSTONE, QUARTZ AND QUARTZITE						
Rough:						
Architectural	48	637	959	39	529	792
Construction [1]	129	1,675	1,499	77	1,012	1,314
Flagging	22	273	1,167	29	361	1,538
Unspecified rough stone	3	33	43	11	146	186
Dressed:						
Cut	20	261	1,003	29	381	1,566
House stone veneer	25	338	767	24	318	791
Flagging	15	185	590	17	213	696
Other dressed stone [9]	35	478	2,408	35	472	2,010
Total [4]	296	3,879	8,437	261	3,431	8,692
SLATE						
Roofing slate [10]	12	--	1,478	14	--	2,149
Millstock:						
Structural and sanitary purposes	20	--	2,950	17	--	2,536
Blackboards, etc.[11]	3	--	662	1	--	238
Billiard table tops	W	--	W	3	--	614
Total [4]	23	--	3,612	20	--	3,388
Flagging	35	--	1,217	29	--	1,288

See footnotes at end of table.

Table 4.—Dimension stone shipped or used by producers in the United States, by use and kind of stone—Continued

(Thousands)

Kind of stone and use	1973 Short tons	1973 Cubic feet	1973 Value	1974 Short tons	1974 Cubic feet	1974 Value
SLATE—Continued						
Flooring	4	--	$489	7	--	$1,146
Other uses [12]	14	--	1,160	8	--	252
Total [4]	88		7,956	79	--	8,223
OTHER STONE [13]						
Rough:						
Architectural	10	123	115	5	51	200
Construction [1]	39	471	583	311	3,671	1,290
Flagging	([6])	3	9	3	30	47
Dressed:						
Cut	5	66	565	5	67	461
Construction	4	59	70	W	W	W
Other dressed stone [14]	5	54	213	3	44	91
Total [4]	64	776	1,555	326	3,864	2,089
TOTAL STONE						
Rough:						
Architectural	252	3,221	6,498	330	4,211	10,381
Construction [1]	358	4,317	4,149	590	7,038	4,986
Monumental	312	3,229	12,266	293	3,004	15,354
Flagging	38	471	1,490	48	602	1,729
Unspecified rough stone	4	52	52	13	169	203
Dressed:						
Cut	118	1,509	20,701	129	1,646	21,033
Sawed	80	1,040	4,531	125	1,642	7,197
House stone veneer	93	1,217	3,523	94	1,233	4,593
Construction	21	265	773	17	212	851
Monumental	45	534	14,157	47	541	16,460
Curbing	139	1,640	7,772	122	1,453	7,882
Flagging	54	227	1,891	49	245	2,076
Roofing (slate) [10]	12	--	1,469	14	--	2,149
Millstock (slate)	23	--	3,612	20	--	3,388
Flooring (slate)	4	--	489	7	--	1,146
Other dressed stone [15]	29	198	2,627	16	90	891
Total [4]	1,582	17,920	85,999	1,915	22,085	100,318

W Withheld to avoid disclosing individual company confidential data.

[1] Includes rubble and irregular shaped stone.

[2] Includes a minor amount of unspecified rough stone for 1974.

[3] Includes data for dressed flagging, paving blocks, and unspecified dressed stone.

[4] Data may not add to totals shown because of independent rounding.

[5] Data include small amount of monumental stone (1974).

[6] Less than ½ unit.

[7] Includes data for flagging and monumental stone (1973).

[8] Data include flagging, uses not specified, and figure where symbol W appears for marble.

[9] Data include curbing, sawed stone, construction stone, and uses not specified.

[10] Includes small amount of slate used for house stone veneer.

[11] Data includes slate used for electrical purposes, and where symbol W appears for slate.

[12] Includes slate used for aquarium bottoms, building stone, fireplaces, monumental purposes (1974), and uses not specified.

[13] Produced by the following States in 1974, in order of value of output and with number of quarries: California (80), Virginia (4), New Jersey (1), Maryland (1), Pennsylvania (3), Hawaii (3), Oregon (20), New Mexico (2), and Washington (8).

[14] Data include sawed stone, house stone veneer, and flagging, 1973 data also include stone used for structural and sanitary purposes.

[15] Data include stone for paving blocks, and uses not specified; slate for aquarium bottoms, building stone, fireplaces, and monumental purposes (1974). 1973 data also include stone used for structural and sanitary purposes (excluding slate).

Table 5.—Granite (dimension stone) shipped or used by producers in the United States in 1974, by State

State	Active quarries	Quantity (short tons)	Value (thousands)
California	106	45,278	$946
Georgia	36	213,628	8,034
Massachusetts	7	79,416	5,355
Missouri	1	1,822	363
New Hampshire	3	62,785	W
North Carolina	9	49,015	2,809
South Carolina	6	12,712	579
South Dakota	7	35,680	8,881
Texas	5	7,441	2,476
Virginia	1	754	25
Washington	1	20	1
Wisconsin	7	7,714	2,452
Other States [1]	50	141,493	19,480
Total	239	657,758	51,401

W Withheld to avoid disclosing individual company confidential data; included with "Other States."

[1] Includes quarries in Colorado (3), Connecticut (3), Maine (2), Minnesota (13), Nevada (7), New York (2), Oklahoma (9), Pennsylvania (1), Rhode Island (1) and Vermont (9).

Table 6.—Limestone and dolomite (dimension stone) shipped or used by producers in the United States in 1974, by State

State	Active quarries	Quantity (short tons)	Value (thousands)
California	6	W	$179
Illinois	1	2,742	70
Indiana	20	240,985	9,342
Iowa	3	14,692	391
Kansas	5	W	513
Minnesota	5	14,092	1,735
Virginia	3	1,041	W
Washington	1	1,769	53
Wisconsin	25	155,328	3,973
Other States [1]	14	85,972	1,894
Total	83	516,621	18,150
Puerto Rico	NA	222,548	1,023

NA Not Available. W Withheld to avoid disclosing individual company confidential data; included with "Other States."

[1] Includes quarries in Alabama (1), Colorado (1), Florida (2), Michigan (2), Missouri (1), New Mexico (1), Ohio (1), Oklahoma (1), Rhode Island (1), and Texas (3).

Table 7.—Sandstone, quartz, and quartzite (dimension stone) shipped or used by producers in the United States in 1974, by State

State	Active quarries	Quantity (short tons)	Value (thousands)
Arizona	19	4,300	$116
Arkansas	5	9,989	253
California	4	1,337	16
Colorado	15	8,517	194
Connecticut	4	23,759	374
Georgia	4	15,672	269
Maryland	4	13,703	273
Missouri	1	680	32
Montana	2	656	W
New York	10	24,979	1,785
Ohio	24	80,851	2,798
Pennsylvania	20	41,430	1,095
Tennessee	4	6,373	369
Wisconsin	6	1,381	35
Wyoming	1	321	W
Other States [1]	21	26,988	1,084
Total	144	260,936	[2] 8,692

W Withheld to avoid disclosing individual company confidential data; included with "Other States."

[1] Includes quarries in Alabama (1), Idaho (1), Indiana (2), Michigan (3), Minnesota (1), New Mexico (1), North Carolina (3), Utah (4), Virginia (3) and Washington (2).

[2] Data do not add to total shown because of independent rounding.

Table 8.—Crushed and broken stone shipped or used by producers in the United States in 1973 and 1974, by kind of stone and use

(Thousand short tons and thousand dollars)

Kind of stone and use	1973		1974	
	Quantity	Value	Quantity	Value
CALCAREOUS MARL [1]				
Agricultural purposes [2]	249	376	531	1,121
Cement manufacture	2,025	2,585	3,180	4,325
Other uses [3]	53	82	179	510
Total [4]	2,327	3,042	3,889	5,956
GRANITE				
Bituminous aggregate	17,468	34,434	18,123	38,500
Concrete aggregate (coarse)	23,670	44,305	21,518	43,014
Dense-graded roadbase stone	40,099	70,367	35,137	69,506
Macadam aggregate	2,724	5,112	3,642	6,835
Surface treatment aggregate	6,763	12,734	5,144	10,984
Unspecified construction aggregate and roadstone	14,805	24,871	16,998	33,427
Poultry grit and mineral food	35	W	42	389
Riprap and jetty stone	2,996	5,992	2,761	5,987
Railroad ballast	6,271	10,056	7,816	13,962
Filter stone	413	990	390	989
Fill	W	W	2,446	6,671
Manufactured fine aggregate (stone sand)	W	W	1,815	3,436
Other uses [5]	5,361	8,012	2,725	4,444
Total [4]	120,606	216,874	118,558	238,144
LIMESTONE AND DOLOMITE				
Bituminous aggregate	r 63,613	r 118,661	62,239	130,416
Concrete aggregate (coarse)	r 116,373	r 207,072	105,188	202,804
Dense-graded roadbase stone	r 179,474	r 280,427	168,469	283,112
Macadam aggregate	30,221	51,617	29,373	53,856
Surface treatment aggregate	r 44,059	r 79,560	46,603	98,585
Unspecified construction aggregate and roadstone	r 82,879	r 136,246	76,563	145,831
Agricultural purposes [6]	r 28,234	r 62,097	34,400	85,054
Riprap and jetty stone	r 16,704	r 28,362	19,382	33,901
Railroad ballast	r 7,992	r 12,503	9,677	16,569
Filter stone	633	1,147	1,305	2,729
Manufactured fine aggregate (stone sand)	5,301	11,614	5,393	12,937
Terrazzo and exposed aggregate	328	4,280	189	1,180
Cement manufacture	106,878	137,202	105,246	157,856
Lime manufacture	33,135	53,770	31,728	58,129
Dead-burned dolomite	3,402	5,775	2,164	3,890
Ferrosilicon	439	522	W	W
Flux stone	27,664	48,409	30,668	59,319
Refractory stone	442	1,208	402	848
Chemical stone for alkali works	2,943	6,529	2,285	5,276
Special uses and products [7]	984	3,482	1,271	6,826
Asphalt filler	795	3,951	1,007	5,465
Whiting or whiting substitute	683	11,653	958	13,390
Other fillers or extenders	2,051	14,078	1,607	11,591
Chemicals	1,181	2,636	W	W
Fill	1,630	2,328	2,644	4,490
Glass	1,724	7,268	1,714	8,395
Sugar refining	639	2,792	928	3,014
Other uses [8]	13,996	26,744	10,119	22,770
Total [4]	774,397	1,321,932	751,515	1,428,282
MARBLE				
Construction and maintenance purposes [9]	665	3,745	149	1,342
Agricultural purposes [10]	14	W	W	W
Terrazzo and exposed aggregate	149	2,282	238	3,294
Mineral fillers, extenders, and whiting	1,038	16,631	1,245	25,217
Other uses [11]	157	738	47	701
Total [4]	2,023	23,395	1,679	30,554
SANDSTONE, QUARTZ, AND QUARTZITE [12]				
Bituminous aggregate	2,645	5,942	3,207	7,642
Concrete aggregate (coarse)	2,258	5,131	2,135	5,171
Dense-graded roadbase stone	7,370	12,273	8,082	15,734
Macadam aggregate	98	157	218	371
Surface treatment aggregate	1,003	1,939	737	1,770
Unspecified construction aggregate and roadstone	6,758	12,143	6,178	12,679
Riprap and jetty stone	2,855	6,075	2,481	4,933
Railroad ballast	914	1,635	1,168	2,205

See footnotes at end of table.

Table 8.—Crushed and broken stone shipped or used by producers in the United States in 1973 and 1974, by kind of stone and use—Continued

(Thousand short tons and thousand dollars)

Kind of stone and use	1973		1974	
	Quantity	Value	Quantity	Value
SANDSTONE, QUARTZ, AND QUARTZITE [12]—Continued				
Filter stone	168	379	60	150
Manufactured fine aggregate (stone sand)	567	1,603	533	2,068
Terrazzo and exposed aggregate	35	573	28	497
Cement manufacture	776	1,700	752	1,654
Ferrosilicon	192	801	279	1,352
Flux stone	1,166	4,840	1,126	4,834
Refractory stone	416	3,043	558	3,886
Abrasives	226	1,253	110	991
Fill	W	W	272	441
Glass	1,034	4,435	1,423	7,327
Other [13]	1,869	5,724	1,743	4,109
Total [4]	30,351	69,647	31,090	77,815
SHELL				
Dense-graded roadbase stone	4,314	8,707	6,903	14,918
Unspecified construction aggregate and roadstone [14]	3,964	10,931	3,154	9,656
Agricultural purposes [10]	425	1,725	946	3,275
Cement and lime manufacture	6,687	11,163	6,642	13,721
Other [15]	4,506	5,124	591	2,056
Total [4]	19,896	37,650	18,285	43,626
TRAPROCK				
Bituminous aggregate	14,070	32,406	14,598	38,765
Concrete aggregate	8,311	21,190	8,530	21,537
Dense-graded roadbase stone	22,058	44,857	22,485	47,655
Macadam aggregate	1,426	2,917	852	1,727
Surface treatment aggregate	4,737	9,322	4,808	9,812
Unspecified construction aggregate and roadstone	20,332	40,903	24,875	61,422
Riprap and jetty stone	4,131	8,094	8,771	15,732
Railroad ballast	2,878	4,885	2,155	4,139
Filter stone	112	253	192	407
Manufactured fine aggregate (stone sand)	604	1,728	810	1,872
Fill	1,799	2,591	6,126	6,578
Other uses [16]	8,502	8,527	3,181	8,252
Total [4]	88,959	177,671	96,885	217,897
OTHER STONE				
Bituminous aggregate	4,459	8,790	4,369	9,379
Concrete aggregate (coarse)	1,378	2,938	1,923	4,086
Dense-graded roadbase stone	7,227	15,492	4,402	9,149
Macadam aggregate	62	132	71	119
Surface treatment aggregate	1,330	1,721	789	1,204
Unspecified construction aggregate and roadstone	3,372	6,884	2,232	3,890
Riprap and jetty stone	1,285	2,099	1,836	2,864
Railroad ballast	654	506	1,010	880
Terrazzo and exposed aggregate	38	154	41	218
Fill	3,044	5,803	1,339	1,886
Other uses [17]	673	1,712	439	1,082
Total [4]	23,516	46,229	18,401	34,715
TOTAL STONE				
Bituminous aggregate	^{r} 102,688	^{r} 201,656	102,845	225,996
Concrete aggregate	^{r} 156,353	285,633	139,293	276,561
Dense-graded roadbase stone	^{r} 260,677	^{r} 432,420	245,565	440,384
Macadam aggregate	34,559	60,005	34,157	62,908
Surface treatment aggregate	^{r} 58,566	^{r} 107,194	58,692	124,516
Unspecified construction aggregate and roadstone	^{r} 131,360	^{r} 229,286	128,869	264,025
Agricultural purposes [6]	^{r} 29,000	^{r} 64,815	36,038	90,337
Riprap and jetty stone	^{r} 28,035	^{r} 50,948	35,292	63,692
Railroad ballast	18,721	29,642	21,835	37,802
Filter stone	1,327	2,770	1,954	4,300
Manufactured fine aggregate (stone sand)	7,748	19,182	8,636	21,557
Terrazzo and exposed aggregate	566	7,542	414	5,022
Cement manufacture	115,487	151,225	115,404	177,102
Lime manufacture	34,070	55,348	32,215	58,743
Dead-burned dolomite	3,402	5,775	2,164	3,890
Ferrosilicon	631	1,323	480	1,816
Flux stone	28,829	53,249	31,789	64,153
Refractory stone	858	4,251	959	4,734
Chemical stone for alkali works	2,943	6,529	2,285	5,276

See footnotes at end of table.

Table 8.—Crushed and broken stone shipped or used by producers in the United States in 1973 and 1974, by kind of stone and use—Continued

(Thousand short tons and thousand dollars)

Kind of stone and use	1973		1974	
	Quantity	Value	Quantity	Value
TOTAL STONE—Continued				
Special uses and products[7]	1,257	5,385	1,490	8,064
Asphalt filler	977	4,404	1,153	5,980
Whiting and whiting substitute	1,076	16,654	1,477	22,964
Other fillers or extenders	2,902	26,459	2,583	28,217
Fill	7,262	11,519	12,881	20,071
Glass	2,759	11,703	3,137	15,728
Expanded slate	1,092	5,954	983	6,822
Paper manufacture	208	674	189	668
Roofing aggregates, chips, and granules	4,246	10,550	4,353	11,267
Sugar refining	639	2,792	928	3,014
Other uses[18]	[r] 20,356	[r] 39,580	13,616	30,284
Total[4]	1,058,541	1,904,464	1,041,627	2,085,837

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[r] Revised. W Withheld to avoid disclosing individual company confidential data.

[1] Produced by the following States in 1974 in order of tonnage: South Carolina, Mississippi, Texas, North Carolina, Michigan, Indiana, and Virginia.

[2] Includes marl used in agricultural limestone, agricultural marl and other soil conditioners, and nutrients.

[3] Data include stone used in dense-graded roadbase stone, unspecified aggregate, and fill.

[4] Data may not add to totals shown because of independent rounding.

[5] Includes stone used in terrazzo, cement manufacture, asphalt filler, roofing aggregates, chips, and granules, building products (1974), bedding material 1974, waste material (1973), uses not specified, and any data represented by the symbol W in granite.

[6] Includes agricultural limestone, other soil conditioners, and poultry grit and mineral food.

[7] Includes stone used for abrasives and mine dusting.

[8] Data include stone used in acid neutralization, building products, bedding material, disinfectant and animal sanitation, drain fields, paper manufacture, porcelain (1974), roofing aggregates, chips, and granules, stucco, waste material, magnesium metal manufacture (1973), use not specified, and any data represented by the symbol W in limestone and dolomite.

[9] Data combined to avoid disclosing confidential data. Includes unspecified aggregate, riprap and jetty stone, and manufactured fine aggregate. 1973 data include macadam aggregate, concrete aggregate, dense-graded roadbase stone, surface treatment and filter stone.

[10] Include agriculture limestone (1973) and poultry grit and mineral food.

[11] Includes roofing aggregates, chips, and granules, other uses not listed, bituminous aggregate (1973), and any data represented by the symbol W in marble.

[12] Includes ground sandstone, quartz, and quartzite.

[13] Includes stone used in poultry grit and mineral food, other filler, building products, drain fields, porcelain, roofing aggregates, chips and granules, waste material, uses not specified, and data represented by the symbol W in sandstone, quartz and quartzite.

[14] Includes stone used for bituminous aggregate, concrete aggregate, and surface treatment aggregate.

[15] Includes stone used for riprap and jetty stone, railroad ballast, asphalt filler (1973), and uses not specified.

[16] Data include stone used for poultry grit, asphalt filler, other fillers or extenders, bedding material, drain fields, roofing aggregates, chips, and granules, waste material, building products (1974), and uses not specified.

[17] Includes stone used for manufacture of fine aggregate, cement manufacture, abrasives, asphalt fillers, other fillers, drain fields, roofing aggregates, chips, and granules, filter stone (1974), building products (1974) bedding material (1974), waste material (1973), and uses not specified (1973).

[18] Data include stone used in acid neutralization, building products, chemicals, bedding material, drain fields, flour (slate), waste material, uses not listed in smaller quantities, and uses not specified.

Table 9.—Number and production of crushed-stone quarries in the United States, by size of operation

Annual production (short tons)	1973			1974		
	Number of quarries	Production		Number of quarries	Production	
		Thousand short tons	Percent of total		Thousand short tons	Percent of total
Less than 25,000	1,600	13,608	1.3	2,156	20,588	2.0
25,000 to 49,999	660	24,221	2.3	687	24,151	2.3
50,000 to 74,999	339	20,485	1.9	374	22,719	2.2
75,000 to 99,999	253	21,941	2.1	259	22,592	2.2
100,000 to 199,999	634	90,974	8.6	604	86,556	8.3
200,000 to 299,999	308	75,868	7.2	332	82,556	7.9
300,000 to 399,999	233	80,946	7.6	278	96,268	9.2
400,000 to 499,999	182	80,956	7.7	166	74,039	7.1
500,000 to 599,999	126	68,903	6.5	129	70,942	6.8
600,000 to 699,999	98	62,730	5.9	94	61,065	5.9
700,000 to 799,999	76	56,694	5.4	69	51,845	5.0
800,000 to 899,999	51	42,718	4.0	55	46,924	4.5
900,000 and over	248	418,502	39.5	228	381,382	36.6
Total	4,808	1,058,541	100.0	5,431	1,041,627	100.0

Table 10.—Crushed stone shipped or used in the United States, by method of transportation

Method of transportation	1973		1974	
	Thousand short tons	Percent of total	Thousand short tons	Percent of total
Truck	830,372	79	828,558	79
Rail	98,771	9	94,439	9
Waterway	77,741	7	80,672	8
Other	31,746	3	28,795	3
Unspecified	19,911	2	9,164	1
Total[1]	1,058,541	100	[1]1,041,627	100

[1] Data do not add to total shown because of independent rounding.

Table 11.—Granite (crushed and broken stone) shipped or used by producers in the United States in 1974, by State

(Thousand short tons and thousand dollars)

State	Quantity	Value	State	Quantity	Value
Alaska	542	1,580	New Mexico	19	36
Arizona	83	121	North Carolina	28,155	W
Arkansas	7,550	13,361	South Carolina	10,000	17,831
California	7,634	16,694	Texas	180	375
Colorado	1,614	2,972	Utah	9	9
Georgia	32,174	65,277	Virginia	17,192	35,229
Michigan	40	W	Washington	318	603
Minnesota	1,439	2,539	Wisconsin	1,347	1,179
Montana	2	2	Other States[1]	6,439	71,373
Nevada	497	915			
New Jersey	3,326	8,048	Total[2]	118,558	238,144

W Withheld to avoid disclosing individual company confidential data; included with "Other States."

[1] Includes Connecticut, Idaho, Maryland, Massachusetts, Missouri, New Hampshire, New York, Oregon, Pennsylvania, Rhode Island, South Dakota, Vermont, and Wyoming.

[2] Data may not add to totals shown because of independent rounding.

Table 12.—Traprock (crushed and broken stone) shipped or used by producers in the United States in 1974, by State

(Thousand short tons and thousand dollars)

State	Quantity	Value	State	Quantity	Value
Alaska	3,294	8,471	Oregon	21,743	39,658
Arizona	1,070	2,253	Pennsylvania	4,307	8,239
California	6,101	11,174	Vermont	W	603
Connecticut	7,971	17,942	Virginia	4,610	10,683
Hawaii	5,637	17,102	Washington	12,929	19,188
Idaho	2,254	4,919	Other States[1]	7,664	19,273
Massachusetts	6,102	16,201			
Minnesota	90	179	Total	[2]96,885	217,897
Montana	1,098	2,196	Puerto Rico	W	W
New Jersey	11,428	38,658	Virgin Islands	638	3,869
New Mexico	586	1,158			

W Withheld to avoid disclosing individual company confidential data; included with "Other States."

[1] Includes Maine, Maryland, Michigan, New Hampshire, New York, North Carolina, Texas and Wisconsin.

[2] Data do not add to total shown because of independent rounding.

Table 13.—Limestone and dolomite (crushed and broken stone) shipped or used by producers in the United States in 1974, by State and use

(Thousand short tons and thousand dollars)

State	Agriculture [1]		Aggregates		Riprap		Railroad ballast		Fluxing stone		Miscellaneous and undistributed		Total [2]	
	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value
Alabama	647	1,658	9.923	15,937	W	W	W	W	2,244	4,284	8,704	15,819	21,518	37,698
Alaska	--	--	W	W	--	--	--	--	--	--	--	--	W	W
Arizona	W	W	W	W	--	--	--	--	338	782	2,282	5,196	2,619	5,978
Arkansas	628	1,710	3,187	6,433	66	85	--	--	W	W	3,249	5,541	7,130	13,769
California	146	863	4,091	6,324	W	W	--	--	W	W	15,689	31,004	19,926	38,191
Colorado	--	--	W	W	W	W	--	--	W	W	4,427	10,519	4,427	10,519
Connecticut	W	W	--	--	--	--	--	--	--	--	198	W	198	W
Florida	1,478	5,154	46,718	84,875	218	547	W	W	--	--	6,146	9,802	54,560	100,378
Georgia	W	W	4,109	10,421	W	W	W	W	--	--	2,752	6,863	6,861	17,285
Hawaii	34	W	431	1,150	--	--	--	--	--	--	1,177	2,391	1,642	3,541
Idaho	6	36	--	--	--	--	--	--	--	--	W	W	W	W
Illinois	5,203	10,039	51,617	99,289	688	1,361	488	814	305	577	4,929	9,613	63,229	121,693
Indiana	1,810	3,716	24,720	44,847	174	380	394	653	W	W	3,644	5,106	30,741	54,702
Iowa	3,322	8,086	23,568	48,574	383	721	827	1,290	W	W	4,227	7,056	32,327	65,728
Kansas	562	1,046	12,117	24,933	935	970	W	W	--	--	3,721	6,295	17,335	33,244
Kentucky	2,238	4,779	25,010	47,213	3,765	7,529	W	W	W	W	3,433	6,716	34,447	66,237
Maine	W	W	166	558	--	--	W	W	--	--	919	2,170	1,085	2,729
Maryland	W	W	10,126	25,454	W	W	W	W	W	W	3,220	9,536	13,346	34,990
Massachusetts	212	W	W	W	--	--	--	--	W	W	W	W	W	W
Michigan	548	954	11,064	17,088	400	589	223	335	13,681	22,435	20,536	26,728	46,451	68,129
Minnesota	334	762	5,680	9,060	55	88	W	W	--	--	403	811	6,472	10,721
Mississippi	W	W	W	W	W	W	--	--	--	--	W	W	W	W
Missouri	4,619	9,700	28,502	53,483	4,512	4,908	24	35	W	W	12,368	19,263	50,024	87,389
Montana	--	--	1	3	8	14	95	160	254	832	1,317	2,144	1,675	3,152
Nebraska	311	1,799	2,973	5,603	283	831	W	W			1,063	2,132	4,630	10,364
Nevada	W	W	216	159	--	--	--	--	W	W	1,371	2,854	1,587	3,012
New Jersey	W	W	W	2,153	--	--	--	--	W	W	W	W	W	W
New Mexico	--	--	1,293	3,503	W	W			31	W	W	W	2,242	5,619
New York	317	1,490	24,758	57,962	448	1,034	177	374	W	W	9,528	15,970	35,229	76,829
North Carolina	W	W	W	W	W	W	W	W	--	--	W	W	W	W
Ohio	2,051	4,400	29,499	55,539	1,141	3,132	1,235	1,873	4,698	9,424	11,461	25,151	50,085	99,517
Oklahoma	376	688	15,999	26,588	1,097	1,551	W	W	--	--	3,647	5,951	21,120	34,777
Oregon	W	W	109	267	--	--			--	--	W	W	W	W
Pennsylvania	2,080	7,366	33,542	65,868	509	1,143	857	1,972	3,944	10,225	16,783	34,714	57,715	121,289
Rhode Island	W	W		--	--	--	--	--	W	W	W	W	W	W
South Carolina	W	W	W	W	W	W			--	--	W	W	W	W
South Dakota	W	W	908	1,754	W	W	W	W	--	--	1,110	1,508	2,019	3,262
Tennessee	2,752	4,931	32,896	55,734	583	1,142	519	836	--	--	4,753	9,536	41,504	72,178
Texas	415	928	40,748	66,389	989	1,998	837	1,601	560	1,598	11,934	17,594	55,483	90,108
Utah	W	W	W	W	18	17	--	--	W	W	1,984	4,664	2,001	4,681
Vermont	112	468	493	948	25	48	W	W	--	--	329	W	959	7,329
Virginia	1,347	3,109	13,831	25,536	52	83	308	474	462	829	4,097	10,294	20,098	40,325
Washington	13	W	W	W	--	--	--	--	W	W	781	1,372	794	1,372
West Virginia	148	320	6,335	13,133	W	W	582	823	W	W	3,159	6,299	10,223	20,575
Wisconsin	907	1,962	16,357	23,479	182	391	149	204	W	W	970	1,753	18,566	27,789
Wyoming	--	--	229	466	W	W	W	W			813	1,878	1,042	2,344
Total	32,616	75,964	481,216	900,723	16,531	28,562	6,715	11,444	26,517	50,986	177,124	324,243	741,310	1,397,443
Undistributed	1,785	9,090	7,219	13,882	2,850	5,340	3,961	5,123	4,146	8,333	10,795	36,310	10,205	30,787
Pacific Island Possessions	W	W	667	1,373	W	W	--	--	--	--	180	193	848	1,566
Puerto Rico	--	--	7,722	18,188	W	W	--	--	--	--	2,824	3,495	10,546	21,682

W Withheld to avoid disclosing individual company confidential data; included with "Undistributed."

[1] Includes agricultural limestone, other soil conditioners, poultry grit, and mineral food.

[2] Data may not add to totals shown because of independent rounding.

Table 14.—Shell shipped or used by producers in the United States in 1974, by State

(Thousand short tons and thousand dollars)

State	Quantity	Value
Louisiana	10,940	24,046
Texas	5,438	15,249
Virginia	1	W
Other States[1]	1,857	4,331
Total	[2]18,235	43,626

W Withheld to avoid disclosing individual company confidential data; included with "Other States."

[1] Includes Alabama, Alaska, California, and Florida.

[2] Data do not add to total shown because of independent rounding.

Table 15.—Calcareous marl shipped or used by producers in the United States in 1974, by State

(Thousand short tons and thousand dollars)

State	Quantity	Value
Indiana	49	62
Michigan	151	258
North Carolina	243	847
South Carolina	2,229	3,310
Other States[1]	1,217	1,479
Total	3,889	5,956

[1] Includes Mississippi, Texas, and Virginia.

Table 16.—Sandstone, quartz and quartzite (crushed and broken stone) shipped or used by producers, in the United States in 1974, by State

(Thousand short tons and thousand dollars)

State	Quantity	Value	State	Quantity	Value
Alaska	716	1,634	Oregon	790	1,919
Arizona	1,092	2,409	Pennsylvania	5,578	12,692
Arkansas	5,435	9,991	South Dakota	911	2,080
California	4,854	10,497	Texas	978	2,412
Colorado	494	1,223	Vermont	32	78
Georgia	127	556	Virginia	1,155	2,603
Idaho	472	2,819	Washington	608	2,147
Kentucky	95	395	West Virginia	731	1,783
Maryland	279	1,284	Wyoming	53	104
Montana	211	637	Other States[1]	4,062	13,081
New Mexico	141	401			
New York	652	1,539	Total	31,090	77,815
Ohio	1,624	5,581			

[1] Includes Alabama, Connecticut, Indiana, Kansas, Maine, Michigan, Minnesota, Missouri, Nevada, North Carolina, Oklahoma, Tennessee, Utah, and Wisconsin.

Table 17.—Miscellaneous varieties of stone (crushed and broken) shipped or used by producers in the United States in 1974, by State

(Thousand short tons and thousand dollars)

State	Quantity	Value	State	Quantity	Value
Alaska	827	988	Oregon	248	467
California	6,718	12,763	Pennsylvania	4,879	10,744
Hawaii	359	727	Rhode Island	11	30
Idaho	127	205	Vermont	84	86
Missouri	90	147	Washington	426	585
Montana	130	255	Other States[1]	3,829	6,374
Nevada	93	160			
New Mexico	543	1,070	Total[2]	18,401	34,715
North Dakota	35	115	Puerto Rico	2,290	15,900

[1] Includes Arizona, Arkansas, Colorado, Kansas, Louisiana, Maine, Maryland, Massachusetts, Minnesota, Oklahoma, South Dakota, Texas, Utah, Virginia, Wisconsin and Wyoming.

[2] Data may not add to totals shown because of independent rounding.

Table 18.—U.S. exports of stone

(Thousand short tons and thousand dollars)

Year	Building and monumental stone			Crushed, ground, or broken				Other manufactures of stone (value)
	Dolomite		Other (value)	Limestone		Other		
	Quantity	Value		Quantity	Value	Quantity	Value	
1972	77	1,025	755	1,730	3,802	1,035	4,298	1,227
1973	59	652	1,244	2,316	5,400	765	4,819	948
1974	86	1,559	1,920	2,793	7,753	625	4,850	2,077

Table 19.—U.S. imports for consumption of stone and whiting, by class

Class	1973		1974	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Granite:				
Monumental, paving and building stone:				
Rough ... cubic feet	344,739	$2,183	184,538	$1,678
Dressed, manufactured ... do	565,771	6,214	370,306	4,544
Not manufactured and not suitable for monumental, paving or building stone ... short tons	3,595	51	2,530	49
Other, n.s.p.f	(1)	135	(1)	3,027
Total	XX	8,583	XX	9,298
Marble, breccia, and onyx:				
In block, rough or squared ... cubic feet	19,124	213	13,089	164
Sawed or dressed, over 2 inches thick ... do	3,780	104	2,273	52
Slabs and paving tiles ... superficial feet	9,165,049	10,033	8,695,485	11,007
All other manufactures	(1)	8,102	(1)	8,121
Total	XX	18,452	XX	19,344
Travertine stone:				
Rough, unmanufactured ... cubic feet	5,262	23	6,846	22
Dressed, suitable for monumental, paving and building stone ... short tons	19,056	3,112	15,029	3,036
Other, n.s.p.f	(1)	155	(1)	185
Total	XX	3,290	XX	3,243
Limestone:				
Monumental, paving, and building stone:				
Rough ... cubic feet	7,394	8	12,056	15
Dressed, manufactured ... short tons	2,244	58	356	37
Crude, not suitable for monumental, paving or building stone ... do	18,864	75	55,486	208
Other, n.s.p.f	(1)	47	(1)	60
Total	XX	188	XX	320
Slate:				
Roofing ... square feet	--	--	1,088	1
Other, n.s.p.f	(1)	6,545	(1)	7,754
Total	XX	6,545	XX	7,755
Quartzite ... short tons	98,137	973	74,977	718
Stone and articles of stone n.s.p.f.:				
Statuary and sculptures	(1)	358	(1)	343
Stone, unmanufactured ... short tons	22,830	1,613	8,196	226
Building stone, rough ... cubic feet	3,969	9	2,023	3
Building stone, dressed ... short tons	3,546	147	743	59
Other	(1)	2,358	(1)	2,581
Total	XX	4,485	XX	3,212
Stone, chips, spall, crushed or ground:				
Marble, breccia, and onyx chips ... short tons	5,378	133	4,602	123
Limestone, chips and spalls, crushed or ground do	1,734,479	2,466	1,787,911	2,537
Stone, chips and spalls, and stone crushed or ground n.s.p.f ... do	1,538,342	2,356	1,733,001	2,997
Total ... **do**	3,278,194	4,955	3,528,514	5,657
Whiting:				
Whiting, dry, ground, or bolted ... short tons	26,653	875	34,181	1,638
Chalk whiting, precipitated ... do	3,332	332	3,345	451
Total ... **do**	29,985	1,207	37,526	2,089
Grand total	XX	48,678	XX	51,631

XX Not applicable.
[1] Quantity not reported.

Sulfur and Pyrites

By Roland W. Merwin [1] and William F. Keyes [2]

There was a marked increase in sulfur prices in 1974 compared with those in 1973. The average net shipment value f.o.b. mine or plant for Frasch and recovered elemental sulfur, which accounted for 92% of the total shipments of sulfur in all forms in 1974, increased by 62% from $17.84 per long ton in 1973 to $28.88 per ton in 1974. There were corresponding increases in both export and import prices. Sulfur prices rose steadily during 1974; therefore, the average prices during 1974 did not fully reflect the substantially higher prices that prevailed at yearend. These higher prices resulted from a continuing substantial upsurge in sulfur demand for fertilizer manufacturing in both domestic and worldwide markets.

Production of sulfur in all forms in 1974 reached an alltime high, being 5% greater than in 1973. For the seventh consecutive year production continued to exceed apparent domestic consumption. Sulfur was produced by 68 companies at 178 operations in 31 States, but 10 companies with 56 operations accounted for 82% of the output. Production was concentrated in Texas and Louisiana. Together, these two States accounted for 83% of the total output. Distribution of production was Frasch sulfur 69%, recovered elemental sulfur 23%, and sulfur contained in other products 8%. There was a substantial increase in the production of both Frasch and recovered elemental sulfur over that of 1973, while the production of sulfur in other forms decreased slightly.

Shipments of sulfur in all forms to domestic and export markets reached an alltime high, being 5% more than those in 1973. The total value of shipments f.o.b. mine or plant was $337.1 million in 1974, compared with $207.8 million in 1973, an increase of 62%. Seventy-seven percent of the shipments were for domestic consumption and 23% for export. Shipments of sulfur in all forms in 1974 were 1% less than the quantity produced. As a result, producers' yearend stocks of Frasch and recovered elemental sulfur, after inventory adjustments, were slightly greater than at yearend 1973.

Apparent domestic consumption of sulfur in all forms reached an alltime high, 6% greater than that of 1973. Sulfur for domestic consumption came mainly from domestic sources: Frasch 49%, recovered elemental 23%, and sulfur in other forms 8%. The remaining 20% of the sulfur consumed was provided by imports of Frasch and recovered elemental sulfur.

The United States maintained its position as a substantial net exporter of sulfur in all forms for the fourth consecutive year. However, the quantity of net exports decreased by 19% compared with that in 1973. Exports of sulfur in all forms were 46% greater than in 1973 and were only 1% less than the alltime record exports in 1965. Imports of sulfur in all forms were at an alltime high, being 76% greater than in 1973. These high levels of exports and imports reflected substantial changes in trade patterns compared with those in 1973.

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[1] Supervisory physical scientist, Division of Nonmetallic Minerals.

[2] Physical scientist, Division of Nonmetallic Minerals.

Table 1.—Salient sulfur statistics

(Thousand long tons, sulfur content, and thousand dollars unless otherwise noted)

	1970	1971	1972	1973	1974
United States:					
Production:					
Frasch	7,082	7,025	7,290	7,605	7,901
Recovered elemental	1,457	1,595	1,950	2,416	2,632
Other forms	1,018	960	978	900	886
Total	9,557	9,580	10,218	10,921	11,419
Shipments:					
Frasch	6,504	6,738	7,613	7,438	7,898
Recovered elemental	1,471	1,582	1,927	2,451	2,547
Other forms	1,018	960	978	900	886
Total	8,993	9,280	10,518	10,789	11,331
Imports, elemental and pyrites	1,667	1,429	1,188	1,222	2,150
Exports, crude and refined	1,433	1,536	1,852	r 1,776	2,601
Consumption, apparent, all forms [1]	9,227	9,173	9,854	r 10,235	10,880
Stocks, Dec. 31: Producer, Frasch and recovered elemental	3,829	4,120	3,796	3,927	3,957
Value:					
Shipments, f.o.b. mine or plant:					
Frasch	$153,809	$117,894	$132,385	$138,578	$241,066
Recovered elemental	30,725	27,483	30,060	37,878	60,599
Other forms	35,958	30,823	32,124	31,358	35,422
Total	220,492	176,200	194,569	207,814	337,087
Imports, elemental [2]	$34,149	$25,419	$16,288	r $14,871	$51,124
Exports, crude [2]	$33,096	$27,844	$32,409	$34,330	$95,516
Price, elemental, dollars per long ton, f.o.b. mine or plant	$23.14	$17.47	$17.03	$17.84	$28.88
World production: All forms (including pyrites)	41,275	42,060	44,776	48,410	50,861

r Revised.

[1] Measured by shipments, plus imports, minus exports.

[2] Declared customs valuation.

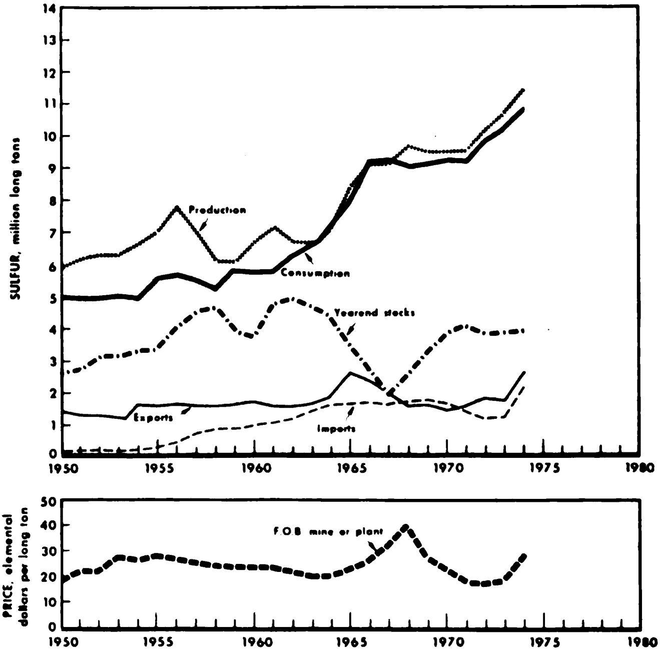

Figure 1.—Trends in the sulfur industry in the United States.

DOMESTIC PRODUCTION

Frasch Sulfur.—Frasch sulfur accounted for 69% of the domestic production of sulfur in all forms in 1974, compared with 70% in 1973. Production reached an alltime high in 1974, and was 4% greater than that of 1973. This record production was attained in the face of rapidly increasing operating costs, mainly in the form of higher natural gas prices. A mitigating factor was the substantially higher price level for Frasch sulfur.

In 1974, 12 Frasch mines produced sulfur. The producers and mines in Louisiana were Freeport Minerals Co. at Garden Island Bay, Grand Isle, Grande Ecaille, and Lake Pelto; and Texasgulf Inc., at Bully Camp. The producers and mines in Texas were Atlantic Richfield Co. at Fort Stockton; Duval Corp. at Rustler Springs; Jefferson Lake Sulphur Co. at Long Point Dome; and Texasgulf Inc., at Boling Dome, Fannett Dome, Moss Bluff Dome, and Spindletop Dome.

The 10 mines operated by Duval Corp., Freeport Minerals Co., and Texasgulf Inc., accounted for most of the Frasch production. Only a relatively small portion of the output was obtained from the other two producers operating one mine each.

Table 2.—Production of sulfur and sulfur-containing raw materials by producers in the United States
(Thousand long tons)

	1971		1972		1973		1974	
	Gross weight	Sulfur content	Gross weight	Sulfur content	Gross weight	Sulfur content	Gross weight	Sulfur content
Frasch sulfur	7,025	7,025	7,290	7,290	7,605	7,605	7,901	7,901
Recovered elemental sulfur	1,595	1,595	1,950	1,950	2,416	2,416	2,632	2,632
Byproduct sulfuric acid (basis 100%) produced at copper, zinc, and lead plants	1,585	518	1,669	546	r 1,834	600	2,001	654
Pyrites	808	316	741	283	559	212	424	162
Other forms[1]	149	126	178	149	107	88	82	70
Total	--	9,580	--	10,218	--	10,921	--	11,419

r Revised.
[1] Hydrogen sulfide and liquid sulfur dioxide.

Table 3.—Sulfur produced and shipped from Frasch mines in the United States
(Thousand long tons and thousand dollars)

Year	Production			Shipments	
	Texas	Louisiana	Total[1]	Quantity	Value[2]
1970	3,446	3,636	7,082	6,504	158,809
1971	3,408	3,616	7,025	6,738	117,894
1972	3,755	3,534	7,290	7,613	132,385
1973	4,294	3,311	7,605	7,438	138,578
1974	4,593	3,308	7,901	7,898	241,066

[1] Data may not add to totals shown because of independent rounding.
[2] F.o.b. mine.

There was a continuing tendency to concentrate production in the larger low-cost mines to counteract the adverse effect of increasing production costs. The five largest mines, with a production rate in excess of one-half million tons per year each, accounted for 81% of the total Frasch sulfur output, compared with 78% in 1973. They also accounted for 56% of the total production of sulfur in all forms during 1974, compared with 54% in 1973. Three medium-size mines, with production rates of more than 250,000 tons per year each, contributed an additional 11% of the year's Frasch production. The remaining 8% of the Frasch output came from four smaller mines.

Producers' shipments of Frasch sulfur were 6% more than those in 1973. This was a result of substantially greater shipments to export markets, as shipments to the domestic market decreased moderately. Approximately 33% of the total shipments were for export (24% in 1973), and 67% were for domestic consumption (76% in 1973). Total shipments were almost equal to production during 1974. However, because of inventory adjustments, producers' reported stocks at yearend 1974 were 2% less than at yearend 1973.

Because of an increase in shipments and the higher prices that prevailed, the total value of Frasch shipments, f.o.b. mine, increased by 74% over that of 1973. The average reported unit shipping value, f.o.b. mine, was $30.52 per long ton in 1974, compared with $18.63 per ton in 1973, an increase of 64%. This increase reflected the substantial improvements in sulfur prices throughout the year; however, these prices did not become fully effective until near yearend 1974.

Recovered Sulfur.—Recovered elemental sulfur accounted for 23% of the total domestic production of sulfur in all forms, compared with 22% in 1973. This reflected the rapidly increasing importance of recovered sulfur as a domestic supply source.

Production and shipments of recovered sulfur in 1974 reached alltime highs, with increases of 9% and 4% respectively over those of 1973. The total value of shipments in 1974 increased by 60% over that of 1973. The average reported industrywide shipment value f.o.b. plant was $23.79 per long ton in 1974, compared with $15.45 per ton in 1973, an increase of 54%. As a result of local competitive factors in the regional markets served by the recovered sulfur producers, including competition from Canadian sources in the northern tier of States, there were wide variations between the reported unit sales prices f.o.b. plant in the different regions of the Nation.

Recovered elemental sulfur production was nondiscretionary in that it was a byproduct from natural gas and petroleum refinery operations. It was produced by 53 companies at 134 plants in 28 States and at 1 plant in the Virgin Islands. Most of the plants were relatively small; only three reported an annual production exceeding 100,000 tons. The 10 largest plants accounted for 39% of the total output, and the combined production of the 5 leading States amounted to 70% of the total. By source, 54% was produced by 35 companies at 75 refineries or satellite plants treating refinery gases, and 46% was produced by 29 companies at 60 natural gas treatment plants.

The five largest recovered elemental sulfur producers were Exxon Co. U.S.A., Getty Oil Co., Gulf Oil Corp., Shell Oil Co., and Standard Oil Co. (Indiana). Together, their 40 plants accounted for 54% of recovered elemental sulfur production in 1974.

Texas and California were the leading recovered elemental sulfur producers, contributing 33% and 15% of the total 1974 output, respectively. Together, the contiguous States of Alabama, Florida, and Mississippi accounted for an additional 22% of the output, mainly from the treatment of dry sour natural gas and sour natural gas associated with petroleum in the deep Jurassic formations underlying these States. Production in this tristate area increased substantially over that of 1973, with indications of a further substantial increase in future years. Additionally, petroleum refineries, particularly those along the coastal areas of the Nation, expected to increase their recovered elemental sulfur production capabilities. It was anticipated that these actions would sharply increase production of recovered elemental sulfur within the next few years.

Table 4.—Recovered sulfur produced and shipped in the United States

(Thousand long tons and thousand dollars)

Year	Production			Shipments	
	Natural gas plants	Petroleum refineries	Total	Quantity	Value [1]
1970	659	798	1,457	1,471	30,725
1971	638	957	1,595	1,582	27,488
1972	819	1,131	1,950	1,927	30,060
1973	1,046	1,370	2,416	2,451	37,878
1974	1,219	1,414	[2] 2,632	2,547	60,599

[1] F.o.b. plant.

[2] Data do not add to total shown because of independent rounding.

Table 5.—Recovered sulfur produced and shipped in the United States, by State

(Thousand long tons and thousand dollars)

State	1973			1974		
	Production (quantity)	Shipments		Production (quantity)	Shipments	
		Quantity	Value		Quantity	Value
Alabama	19	19	W	120	116	3,503
Arkansas	24	24	343	25	25	553
California	414	433	4,539	394	382	4,716
Florida	224	225	3,529	250	249	W
Illinois and Indiana	168	168	3,562	181	181	5,678
Kansas	W	W	W	9	9	218
Louisiana	[1] 242	[1] 243	[1] 3,866	70	69	1,938
Michigan and Minnesota	54	53	929	49	48	1,197
Mississippi	([2])	([2])	([2])	217	141	3,780
New Jersey	82	82	1,898	71	70	2,255
New Mexico	35	33	364	34	35	942
New York	4	4	W	3	3	W
Ohio	7	7	W	10	10	292
Oklahoma	1	1	8	W	W	W
Pennsylvania	25	25	461	26	26	639
Texas	843	847	12,018	856	861	19,746
Wisconsin	W	W	W	2	2	24
Wyoming	50	49	W	55	52	W
Other States [3]	224	233	6,361	261	269	15,118
Total [4]	2,416	2,451	37,878	2,632	2,547	60,599

W Withheld to avoid disclosing individual company confidential data; included with "Other States."

[1] Includes Mississippi in 1973.

[2] Included with Louisiana in 1973.

[3] Combined to avoid disclosing individual company confidential data; includes Colorado, Delaware, Kansas (1973), Missouri, Montana, North Dakota, Oklahoma (1974), Utah, Virginia, Washington, and Virgin Islands.

[4] Data may not add to totals shown because of independent rounding.

Byproduct Sulfuric Acid.—The sulfur contained in byproduct sulfuric acid produced at copper, lead, and zinc roasters and smelters during 1974 amounted to 6% of the total domestic production of sulfur in all forms, compared with 5% in 1973. The total output was 9% more than in 1973, and the value of shipments was 21% more than in 1973. This output was produced by 12 companies at 22 plants in 13 States. Twelve acid plants operated in conjunction with copper smelters, and 10 plants operated as accessories to lead and zinc roasting and smelting operations. The five largest acid plants accounted for 49% of the output, and the combined production of five States amounted to 78% of the total.

The five largest producers of byproduct sulfuric acid were American Smelting and Refining Co., The Bunker Hill Co., Kennecott Copper Corp., Phelps Dodge Corp., and St. Joe Minerals Corp. Together, their 14 plants produced 73% of the output during 1974.

A number of additional byproduct sulfuric acid plants were either under construction in 1974 or in the planning stage. Current production was a relatively small proportion of the potential production at smelters, particularly at copper smelters. Additionally, existing environmental regulations required more effective sulfur oxide emission controls. With these conditions prevailing, it was anticipated that this type of sulfur production would increase rapidly during the next few years.

Table 6.—Byproduct sulfuric acid[1] (sulfuric content) produced in the United States
(Thousand long tons and thousand dollars)

Year	Copper plants[2]	Lead and zinc plants[3]	Total	Value
1970	218	318	[4] 537	23,744
1971	234	284	518	21,293
1972	295	251	546	22,897
1973	318	282	600	24,175
1974	373	281	654	29,370

[1] Includes acid from foreign materials.
[2] Excludes acid made from pyrites concentrates in Arizona, Montana, Tennessee, and Utah.
[3] Excludes acid made from native sulfur.
[4] Data do not add to total shown because of independent rounding.

Pyrites, Hydrogen Sulfide, and Sulfur Dioxide.—The sulfur contained in pyrites, hydrogen sulfide, and sulfur dioxide amounted to 2% of the total domestic production in all forms during 1974, compared with 3% in 1973. The total sulfur content in these products was 23% less than in 1973, and the shipment value of these combined products decreased 16% below that of 1973. These conditions reflected the decreasing importance of these products as a source of U.S. sulfur supply.

Pyrites was produced by three companies at three mines in three States, hydrogen sulfide by three companies at four plants in three States, and sulfur dioxide by two companies at two plants in two States. The three largest producers of these products were Cities Service Co. (pyrites, hydrogen sulfide, and sulfur dioxide), Phillips Petroleum Co. (hydrogen sulfide), and Shell Oil Co. (hydrogen sulfide). Together, their one mine and five plants accounted for 93% of the contained sulfur produced in the form of these products.

Table 7.—Pyrites, hydrogen sulfide, and sulfur dioxide sold or used in the United States
(Thousand long tons of sulfur content and thousand dollars)

Year	Pyrites	Hydrogen sulfide and sulfur dioxide	Total	Value
1970	339	142	481	12,214
1971	316	126	442	9,530
1972	283	149	432	9,227
1973	212	88	600	7,188
1974	162	70	232	6,052

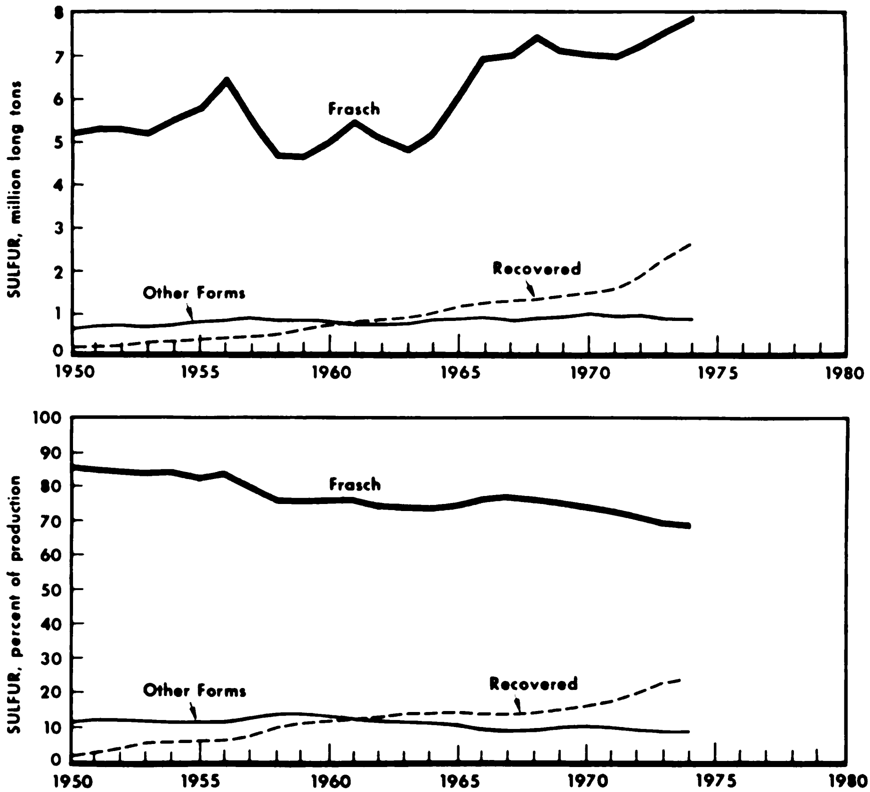

Figure 2.—Trends in the production of sulfur in the United States.

CONSUMPTION

Apparent domestic consumption of sulfur in all forms reached an alltime high in 1974, about 6% more than in 1973. This high level of consumption reflected a substantial improvement in demand by the domestic fertilizer industry, which was strong enough to offset a weakness in demand in the industrial sector. With many new phosphoric acid plants either coming into production, under construction, or in the planning stage, there were indications that domestic consumption would continue to improve during the next several years.

Eighty percent of the sulfur for domestic consumption was obtained from domestic sources, compared with 88% in 1973. The percentage distribution of supply sources was as follows: Domestic Frasch sulfur 49%, as compared with 55% in 1973; domestic recovered elemental sulfur 23%, compared with 24% in 1973; and combined domestic byproduct sulfuric acid, pyrites, hydrogen sulfide, and sulfur dioxide 8%, compared with 9% in 1973. The remaining 20% of the sulfur was obtained from imports of Frasch and recovered elemental sulfur, compared with 12% in 1973.

Apparent sales of domestic Frasch sulfur to domestic consumers decreased by 365,000 tons, or 6% below those in 1973. Domestic producers of recovered elemental sulfur increased their apparent sales to domestic consumers by 96,000 tons, or 4% over those in 1973. The reported sale or use of byproduct sulfuric acid, pyrites, hydrogen sulfide, and sulfur dioxide by domestic producers in domestic markets decreased by 14,000 tons, or 2% below those in 1973. Imports of Frasch and recovered elemental sulfur for domestic consumption increased by 928,000 long tons, or 76% above those in 1973. By source, imports from Mexico increased by 652,000 tons and those from Canada by 289,000 tons, while imports from other countries decreased by 13,000 tons.

Marketing strategies, logistic considerations, and price structures all contributed to the changes in consumption patterns by sources in 1974, compared with those in 1973. Available Frasch sulfur was channeled to higher priced world markets in which a strong demand existed, pending completion of domestic phosphoric acid plants to which forward commitments had been made. While Canadian imports of recovered elemental sulfur increased, their market penetration was limited by logistic considerations to the northern tier of States, a region that had only a limited market potential. Higher prices removed the restrictions on Mexican imports caused by antidumping duties. This factor, combined with a strong increase in demand in the southern States, allowed Mexico to resume its former position as a major supplier of Frasch sulfur to U.S. markets. As a result, supplies of domestic sulfur in all forms to the domestic market decreased by 283,000 tons below those of 1973. However, imported supplies of Frasch and recovered elemental sulfur increased by 928,000 tons, for a net increase in apparent domestic consumption of 645,000 tons.

Approximately 90% of all sulfur consumed was converted to sulfuric acid prior to eventual end use. The manufacture of fertilizers accounted for approximately 55% of all domestic sulfur consumption. Together, plastic and synthetic products, paper products, paints, nonferrous metal production, and explosives accounted for approximately 21% of domestic demand. The remaining 24% was used for a large number of relatively small individual end uses.

The approximate distribution of consumption was as follows: Southern States except Florida 42%; Florida 28%; North-Central States 11%; Western States 11%; and Northeastern States 8%.

Table 8.—Apparent consumption of sulfur in the United States

(Thousand long tons)

	1970	1971	1972	1973	1974
Frasch:					
Shipments	6,504	6,738	7,613	7,438	7,898
Imports	539	449	269	302	954
Exports	1,433	1,536	1,852	[r] 1,776	2,601
Total	5,610	5,651	6,080	[r] 5,964	6,251
Recovered:					
Shipments	1,471	1,582	1,927	2,451	2,547
Imports	998	850	869	920	1,196
Total	2,469	2,432	2,796	3,371	3,743
Pyrites:					
Shipments	339	316	283	212	162
Imports [e]	130	130	50	--	--
Total	469	446	333	212	162
Byproduct sulfuric acid	537	518	546	600	654
Other forms [2]	142	126	149	88	70
Total all forms	9,227	9,173	9,854	[r] 10,235	10,880

[e] Estimate. [r] Revised.

[1] Crude sulfur or sulfur content.

[2] Includes consumption of hydrogen sulfide and liquid sulfur dioxide.

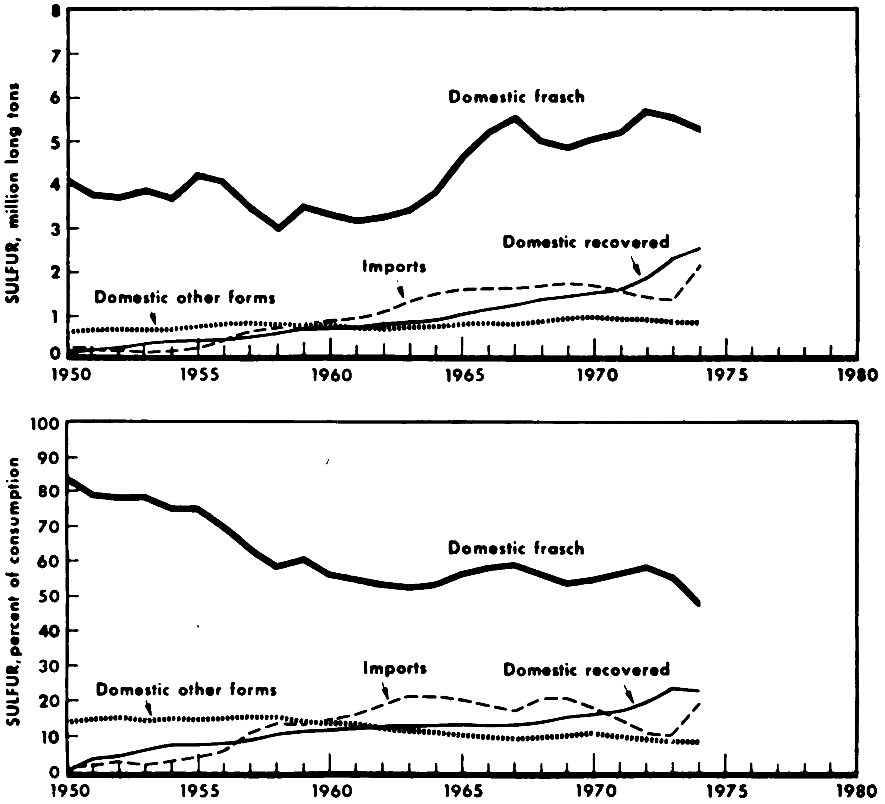

Figure 3.—Trends in the consumption of sulfur in the United States.

STOCKS

Yearend producers' stocks of combined Frasch and recovered elemental sulfur, after inventory adjustments, were 1% greater than at yearend 1973. There was a small decrease in Frasch stocks and a small increase in recovered elemental sulfur stocks. The combined yearend stocks amounted to approximately a 4.5-month supply based on the 1974 domestic and export demands for domestically produced Frasch and recovered elemental sulfur.

Table 9.—Producers' yearend stocks
(Thousand long tons)

Year	Frasch	Recovered	Total
1970	3,744	85	3,829
1971	4,023	97	4,120
1972	3,665	131	3,796
1973	3,816	111	3,927
1974	3,744	213	3,957

PRICES

Producers of Frasch and recovered elemental sulfur report annually on the value of their shipments, f.o.b. mine or plant. Such values vary widely between different mines or plants, depending upon prevailing selling prices in the markets they individually serve and the transportation costs to these markets.

The values f.o.b mine or plant do not necessarily reflect the ultimate selling prices because most sales of elemental sulfur, generally in the form of molten sulfur, are made ex-terminal near the points of consumption. Due to the highly competitive nature of the transactions, such prices are generally not made available.

Beginning in March 1974, and continuing through November 1974, major Frasch sulfur producers independently announced successive increases in the price of liquid sulfur ex-terminals. As a result of these increases, the quoted price of liquid sulfur ex-terminal, Tampa, Fla., the major U.S. marketing point, was $57 per long ton at yearend 1974, compared with $31 per ton at yearend 1973, an increase of 84%. There were similar price increases at other major marketing terminals.

These Frasch sulfur price increases were accepted by major consumers, particularly by the large fertilizer manufacturers in the Southeastern United States. It was recognized that Frasch sulfur production costs had increased to the point where certain low-cost Frasch mines could not continue to operate at the very low price levels that had prevailed for several years. It was also evident that a strong demand for sulfur in foreign markets created a condition in which the Frasch industry found it more profitable to sell in the export market than in the domestic market at the prices prevalent in early 1974. Additionally, the fertilizer manufacturing industry was expanding and required assured forward commitments of sulfur to supply large phosphoric acid plants that were under construction. It appeared to fertilizer manufacturers that the Frasch industry, with its large production capability, ample stocks, and well-established distribution facilities, offered the most assured source of supply for their expanding facilities. Finally, and this was a decisive factor, the high prices being obtained for finished fertilizers allowed the phosphate fertilizer manufacturers to pay substantially higher prices for sulfur.

However, because of the timing of the increases throughout the year and because of contractual agreements that further delayed their implementation, the higher price levels did not become fully effective until yearend 1974. As a result, the average sales value of shipments of Frasch sulfur f.o.b. mine for both domestic consumption and exports during 1974 rose to only $30.52 per long ton, compared with $18.63 per ton in 1973, an increase of $11.89 per ton, or 64%.

The recovered elemental sulfur industry was not able to obtain the full benefit of higher sulfur prices. This was because its marketing position was less favorable than that of the Frasch sulfur industry because it was subject to regional competitive factors and was more dependent upon sales to the industrial sector. Additionally, as recovered elemental sulfur is a nondiscretionary byproduct, there was a general tendency for the industry to sell in local markets at prices that were competitively lower than those of sulfur from other sources. Prices varied widely in different regions of the Nation as a result of these competitive factors. Overall, the reported unit shipment values f.o.b. plant in 1974 were $23.79 per ton, compared with $15.45 per ton in 1973, an increase of $8.34 per ton, or 54%.

Price increases for sulfur produced in other than the elemental form were considerably lower than those for elemental sulfur. This reflected the competitive positions prevailing in the limited regional markets for these products. As a result, the sales values, f.o.b. plant, of shipments of sulfur contained in byproduct sulfuric acid increased by only $4.62 per ton of contained sulfur, or 11% more than the prices prevailing during 1973. Similarly, the unit values, f.o.b. mine or plant, of sulfur contained in pyrites, hydrogen sulfide, and sulfur dioxide increased by only $2.13 per ton of contained sulfur, or 9% over that of 1973.

Table 10.—Reported sales values of shipments of elemental sulfur, f.o.b. mine or plant

(Dollars per long ton)

Year	Frasch	Recovered	Total
1970 --------	23.65	20.89	23.14
1971 --------	17.50	17.37	17.47
1972 --------	17.39	15.60	17.03
1973 --------	18.63	15.45	17.84
1974 --------	30.52	23.79	28.88

FOREIGN TRADE

The United States maintained its position as a net exporter of sulfur in 1974. However, net exports were substantially less than in 1973. Exports of sulfur in all forms in 1974 were 46% more than those in 1973, and imports of all forms were 76% more than those in 1973. As a result, total exports of sulfur exceeded total imports by only 451,000 long tons in 1974, compared with 554,000 tons in 1973, a decrease of 103,000 tons, or 19%.

The maintenance of the favorable export-import balance reflected the ability of the Frasch industry to expand its exports to a near alltime high in the face of heavy imports of Frasch and recovered sulfur that were at an alltime high. The Frasch industry, with its high production rate, ample stocks, and well-established export facilities, was able to channel its available sulfur to higher priced world export markets where a strong unsatisfied demand existed. This reflected the continued reliance in the world markets upon U.S. Frasch producers as an assured source of supply during a period in which logistic problems limited sulfur exports from Canada and production problems in Poland made that source of supply uncertain.

Higher prices in the U.S. market and logistic considerations combined to increase the imports of sulfur, moderately in the case of Canada and very strongly in the case of Mexico. Imports from Canada increased because of higher prices and the availability of additional transportation equipment that allowed Canadian sulfur to further penetrate the U.S. market in the northern tier of States. Higher prices for sulfur in the United States removed the restrictions on Mexican imports into their natural market in the southern area of the United States formerly imposed under the provisions of the Antidumping Act.

Exports were almost entirely in the form of Frasch sulfur. The tonnage of crude sulfur exported during 1974 was 46% greater than in 1973, and only 2% less than the previous alltime record exports in 1965. The total value of these exports increased by 178% over that of 1973. The average reported export value was $37.02 per ton in 1974, compared with $19.38 per ton in 1973, an increase of 91%. Together, Belgium and the Netherlands received 54% of these exports, mainly for transshipment to other European Community (EC) countries. Brazil, with 13%, was the third largest customer.

Following the pattern set in 1973, imports of sulfur in 1974 were entirely in the form of elemental sulfur. The total quantity of elemental sulfur imported in 1974 was 76% more than in 1973, and 20% greater than the previous alltime record imports of combined elemental sulfur and sulfur contained in pyrites in 1969. The total value of imports increased by 244% over that of 1973. The average declared customs value in 1974 was $23.78 per ton, compared with $12.17 per ton in 1973, an increase of 95%.

Imports of sulfur consisted largely of recovered sulfur from Canada and Frasch sulfur from Mexico. Imports from Canada reached an alltime high in 1974, being 32% greater than in 1973. Imports from Mexico were 216% greater than in 1973; 7% greater than the previous alltime peak imports in 1964; and 47% greater than the average imports during 1967–71, the period prior to the imposition of antidumping duties.

Table 11.—U.S. exports of sulfur
(Thousand long tons and thousand dollars)

Year	Crude		Refined	
	Quantity	Value	Quantity	Value
1970	1,429	33,096	4	955
1971	1,532	27,844	4	1,019
1972	1,847	32,409	5	1,278
1973	1,771	34,330	r 5	1,461
1974	2,580	95,516	21	1,829

r Revised.

Table 12.—U.S. exports of crude sulfur, by country

(Thousand long tons and thousand dollars)

Destination	1973		1974	
	Quantity	Value	Quantity	Value
Argentina	39	743	68	2,403
Australia	81	1,924	176	5,722
Belgium-Luxembourg	659	11,389	873	35,516
Brazil	236	4,723	332	12,107
Canada	45	1,203	50	1,465
Canary Islands	7	191	--	--
Chile	36	1,120	46	1,937
Colombia	([1])	1	5	272
Finland	--	--	10	339
France	--	--	11	322
Germany, West	([1])	8	20	302
Greece	--	--	14	342
India	([1])	3	11	441
Ireland	26	448	([1])	5
Israel	7	138	15	473
Italy	41	874	136	4,891
Korea, Republic of	--	--	8	675
Mexico	1	49	4	104
Morocco	--	--	20	1,080
Mozambique	--	--	59	3,520
Netherlands	453	8,422	521	14,914
New Zealand	72	1,636	33	1,033
Senegal	--	--	7	427
South Africa, Republic of	([1])	1	([1])	56
Spain	8	199	14	579
Taiwan	7	202	--	--
Tunisia	--	--	114	3,947
United Kingdom	43	757	3	96
Uruguay	7	153	18	666
Zaire	--	--	6	474
Other	3	146	6	403
Total	1,771	34,380	2,580	95,516

[1] Less than ½ unit.

Table 13.—U.S. imports of sulfur[1]

(Thousand long tons and thousand dollars)

Year	Elemental		Pyrites[2]	
	Quantity	Value	Quantity[e]	Value
1970	1,537	34,149	130	NA
1971	1,299	25,419	130	NA
1972	1,188	16,288	60	NA
1973	1,222	[r]14,871	--	--
1974	2,150	51,124	--	--

[e] Estimate. [r] Revised. NA Not available.

[1] Crude sulfur or sulfur content.

[2] From Canada.

Table 14.—U.S. imports of elemental sulfur, by country

(Thousand long tons and thousand dollars)

Country	1973		1974	
	Quantity	Value	Quantity	Value
Canada	905	8,412	1,194	20,692
Germany, West	1	[r]242	([1])	105
Guyana	([1])	([1])	1	4
Mexico	302	6,013	954	30,298
Trinidad and Tobago	14	202	--	--
United Kingdom	([1])	2	1	21
Other[3]	--	--	([1])	4
Total	1,222	[r]14,871	2,150	51,124

[r] Revised.

[1] Less than ½ unit.

[3] 1974—France.

WORLD REVIEW

Reacting to a tight supply situation, sulfur prices rose rapidly throughout the world during 1974, reaching alltime highs by yearend. This tight supply position was primarily due to a continuing upsurge in sulfur demand for phosphatic fertilizer manufacturing which, combined with a projected still further higher demand in this sector, was of a magnitude that more than compensated for a weakness in demand for industrial uses of sulfur. Logistic problems which restricted the movement of sulfur from major producing areas with large producers' stocks, such as Canada, further contributed to this situation. Additionally, consumers reacted to rising prices and potential future shortages by increasing their stocks at points of consumption, particularly in northeast Europe and the Mediterranean region, and to a lesser extent in other consuming countries. However, at yearend 1974 there were indications that, as a result of an unexpected weakness in fertilizer demand and a continuing slackness in industrial consumption, there was a marked easing of demand for sulfur in world markets.[3] This condition continued into 1975 with the outlook for the future being uncertain.

Continuing the pattern prevalent during the past several years, world production of sulfur in all forms exceeded world demand by a substantial amount. This was reflected by an increase in producers' stocks of approximately 2.2 million long tons, with most of the increase being accounted for by a buildup in stocks of Canadian recovered elemental sulfur. Additionally, there was a substantial increase in Frasch sulfur stocks in Iraq. There were substantial increases in the production of Frasch sulfur, recovered elemental sulfur, and byproduct sulfuric acid compared with the previous year. However, the pyrites producing sector of the sulfur industry continued to face increasingly serious problems. Pyrites, particularly noncuprous pyrites, was becoming increasingly noncompetitive with elemental sulfur in the world markets, even at higher price levels for the elemental form.

Increasing attention was being given to the production of byproduct recovered elemental sulfur at refinery and natural gas plant operations in the Near East.[4] Nearly one-third of the world's reserves of sulfur recoverable at present price levels, using current technology, are located in this region. Most of the reserves are in the form of sulfur associated with sour petroleum and sour natural gas. If announced and prospective plans for large refinery installations, petrochemical complexes, and gas liquefaction plants materialize, the region could become one of the world's largest elemental sulfur producers.

While present plans propose that a substantial portion of the sulfur production would be utilized by local fertilizer plants, it is probable that most of the potential production would be exported to world markets in the form of elemental sulfur. Stabilization of political conditions in the Near East, with the assurance that the Suez Canal would remain open, would make this sulfur an attractive source of supply for Europe and North Africa.

The countries in the Near East, with their larger reserves of sulfur, and the countries in North Africa, with their large reserves of phosphate rock, all aspire to become large-scale manufacturers of finished phosphatic fertilizers for world markets. It has been proposed that an economical shipping arrangement that could meet the aspirations of both regions would be the shipping of bulk sulfur to North Africa and a backhaul of phosphate rock to the Persian Gulf.

The Caribbean area was also rapidly emerging as a major source of world elemental sulfur supply.[5] This was being brought about by the construction and expansion of large refineries treating sour crude petroleum for the production of low-sulfur residual fuel oils, with sulfur being recovered as a byproduct. There has been a tenfold increase in sulfur production capacity since 1968, with substantial additions in the construction and planning stages.

Shifting world trade patterns, the rapid development of new sources of elemental sulfur production, and environmental problems, such as the dusting associated with the shipment and storage of bulk, crushed crude sulfur have led many major producers to restudy their overseas transportation methods. Consumers prefer liquid sulfur deliveries. However, increasingly higher construction costs for the specialized liquid sulfur tank ships have mitigated against further expansion of this method of transport. The use of slate sulfur for bulk overseas shipments has partially alleviated the problem of dusting, but it has not been entirely effective in this respect. It has been proposed that pelletizing or prilling of elemental sulfur would provide a more satisfactory product for large-scale movement in international trade. Several relatively small plants for the production of pellets or prills have been built to evaluate these products from the standpoint of shipping characteristics, dusting problems, and consumer acceptance.

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[3] Sulphur (London). Sulphur Demand Pressure Eases Outside North America. No. 115, November/December 1974, pp. 5–6.

[4] Sulphur (London). Arabian Gulf Brimstone Supply—Potential Remains for a Massive Boost in Output. No. 116, January/February 1975, pp. 21–30.

[5] Sulphur (London). Caribbean Recovered Sulphur Boom—Capacity Rapidly Approaching One Million Tons Per Year. No. 112, May/June 1974, pp. 35–44.

Canada.—The production of sulfur in all forms declined slightly from 8.0 million long tons in 1973 to 7.8 million tons in 1974. Recovered elemental sulfur produced at sour natural gas plants, refineries, and tar sand operations accounted for 91% of the output. The sulfur contained in byproduct sulfuric acid produced at nonferrous metal smelters accounted for essentially all of the remaining 9% of the output because there was only a negligible production of pyrites in 1974.

The Province of Alberta accounted for 87% of the Canadian output in 1974. All of the production was in the form of recovered elemental sulfur essentially from plants treating sour natural gas, with only a small fraction of the output being obtained at tar sand operations. Alberta's production of recovered elemental sulfur declined from an alltime peak of 7.0 million tons in 1973 to 6.8 million tons in 1974. Alberta's shipments of sulfur increased from 4.0 million tons in 1973 to 4.9 million tons in 1974. Of these shipments, 3.1 million tons was offshore shipments to foreign markets other than the United States, compared with 2.6 million tons in 1973. As in previous years, practically all of these offshore shipments were through the port of Vancouver, British Columbia. Mainly as a result of improvement in shipments, producers' stocks increased by only 1.9 million tons during 1974, compared with a 3.0 million ton increase in 1973; producers' stocks at yearend 1974 amounted to 13.5 million tons, compared with 11.6 million tons at yearend 1973. The value of marketed sulfur f.o.b. plant rose steadily throughout the year, increasing from $6.58 per long ton in December 1973 to $18.54 per ton in December 1974.[6] There were indications that, as old contracts expired, the value of a marketed sulfur would rise to about $25 per ton early in 1975.

Canadian analysts have concluded that Alberta production probably peaked in 1973 and that, in the absence of any new major sour natural gas discoveries, declining production curves already visible in several large fields will drop Alberta's sulfur production substantially by 1980. On the other hand, they also concluded that the next 5 years will probably be the longest term of sustained profitable marketing in the industry's history.[7]

The Province of Alberta's elemental sulfur producers continued their efforts to develop a more viable method for marketing their output. Working through the Sulphur Development Institute of Canada (SUDIC), an industry task force was working on the total logistic problem of moving Alberta's sulfur. They were reviewing all methods of forming, such as slating, prilling, and pelletizing, and studying the relative economics of all forms of transportation, including unit trains, pipelines, and liquid sulfur movements.[8]

The Province of Alberta Energy Resources Conservation Board estimated that the proved remaining recoverable reserves of sulfur from sour natural gas in the Province were approximately 168 million long tons at yearend 1974. It was also estimated that the proved remaining recoverable reserves of sulfur in the Athabasca tar sands amounted to 186 million tons and that the ultimate recoverable reserves of sulfur in crude bitumen in the Alberta tar sands would be about 1.7 billion tons.[9]

France.—Société Nationale des Pétroles d'Aquitaine, France's major recovered elemental sulfur producer, reported that it had discovered substantial new sour natural gas reserves in the Meillon field near the company's Lacq recovered sulfur complex in southwestern France.[10] This new discovery, at depths greater than 15,000 feet, should improve France's position as a major supplier of sulfur to the European market.

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[6] Energy Resources Conservation Board, Province of Alberta, Canada. Summary of Monthly Statistics. Alberta Energy Resource Industries. December 1974, p. 10.

[7] U.S. Consulate, Calgary, Canada. State Dept. Airgram A-08, Jan. 20, 1975, p. 1, with enclosures.

[8] Energy Processing (Canada). Opportunities for Improving Handling and Transportation Facilities for Sulfur. V. 67, No. 3, January/February 1975, p. 20.

[9] Energy Resources Conservation Board, Province of Alberta, Canada. Reserves of Crude Oil, Gas, Natural Gas Liquids, and Sulfur, Province of Alberta. Dec. 31, 1974, pp. 8-1 to 8-6.

Germany, West.—The byproduct production of recovered elemental sulfur at sour natural gas treatment plants was being expanded rapidly. It was anticipated that production from this source would soon exceed 900,000 tons per year.[11]

Iran.—Iran has advanced more rapidly than other Near East countries in developing the production of recovered elemental sulfur at refineries and natural gas treatment plants. The production has been largely linked with the establishment of fertilizer, petrochemical, and natural gas liquefaction complexes. Plans have been announced for substantial expansions in these industries and for the building of large sulfur recovery units at existing and proposed petroleum refineries. This should lead to a rapid expansion of Iranian sulfur producton within the next decade.[12]

Iraq.—Expansion of facilities at the Mishraq Frasch sulfur mine increased its rated production capacity to 1 million tons per year. Owned and operated by the National Iraqi Minerals Co. (NIMCO), a wholly-owned Government company, this large mine is located near Mosul, about 250 miles north of Baghdad. Long recognized as containing one of the world's major Frasch sulfur deposits, the Mishraq mine and related shipping facilities were developed under the technical direction of Centrozap, the Polish mining engineering institute. NIMCO has been developing a marketing program, primarily export oriented, for both the Mishraq output and the substantial production of recovered elemental sulfur at Kirkuk, 150 miles north of Baghdad. Presently most of the output will be railed to the port of Umm Qasr on the Persian Gulf, about 550 miles south of Mishraq. There were also plans to link the Iraqi-Syrian railroad systems to provide a more direct outlet to the Mediterranean market.[13]

Japan.—The sulfur industry was faced with the problem of actual and potential oversupplies of sulfur in all forms. This has been brought about by the rapid expansion of recovered elemental sulfur production facilities at refineries and byproduct sulfuric acid production at nonferrous metal smelters. Recovered elemental sulfur production at refineries was greatly in excess of demand for this product. A cutback in refinery runs during the latter half of 1974 somewhat alleviated this problem. Additionally, some excess elemental sulfur was exported. The oversupply of byproduct sulfuric acid, which became evident in late 1974, led many nonferrous smelting companies to consider cutbacks in metal output to counteract the problem.

Mexico.—Continuing an upturn that began in 1973, conditions in the Frasch-based sulfur industry again improved substantially in 1974. This was primarily due to higher prices in world markets. Production increased from 1.6 million tons in 1973 to 2.3 million tons in 1974. Similarly exports increased from 0.8 million tons in 1973 to 1.9 million tons in 1974. Substantially larger shipments to the U.S. market accounted for approximately two-thirds of the increase in exports.

Poland.—Poland continued to improve its position as one of the major suppliers of sulfur to the European market. Production capacity was being increased, and emphasis was being placed on improving the marketing of sulfur. It was anticipated that the ongoing expansion of Poland's fleet of liquid sulfur tankers would reduce, and eventually eliminate, exports of crushed, dry, bulk sulfur. Additionally, Poland is expanding its sulfur-forming facilities so as to be able to increase its exports of prilled and pelletized sulfur.

Saudi Arabia.—With large proven reserves of sulfur associated with sour natural gas, Saudi Arabia was planning to become a major sulfur producer. It has been proposed to build a $4.5 billion gathering, sweetening, processing, and distribution project to handle 3.7 billion cubic feet per day of sour natural gas, most of which is presently flared. This project would produce approximately 3.5 million tons of recovered elemental sulfur per year.[14]

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[10] Sulphur (London). New Plants and Projects. No. 112, May/June 1974, p. 10.

[11] Sulphur (London). New Plants and Projects. No. 113, July/August 1974, p. 11.

[12] Pages 24–27 of work cited in footnote 4.

[13] Sulphur (London). Iraq Emerges as Major Sulphur Exporter. No. 111, March/April 1974, pp. 36–40.

U.S.S.R.—While pyrites continued to maintain its position as one of the most substantial sources of sulfur production, there was an increasing degree of reliance upon the production of sulfur in other forms. Particular attention was being given to the production of recovered elemental sulfur as a byproduct at sour natural gas treatment plants. A new gas desulfurization plant was placed into operation at the Orenburg complex.[15] A third-stage expansion at the complex was planned, which would make it one of the largest single recovered elemental sulfur operations in the world, with an output of approximately 750,000 tons of sulfur per year. The production of native sulfur was to be increased by the development of a large Frasch sulfur mine with an initial capacity of 600,000 tons per year at the Yaborova complex in the sub-Carpathian region. Additionally, there were plans to increase the production of byproduct sulfuric acid at nonferrous smelter operations.

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[14] Oil & Gas Journal. Newsletter. V. 23, No. 16, Apr. 21, 1975, p. 1.

[15] Sulphur (London). New Plants and Projects. No. 116, January/February 1975, p. 14.

Table 15.—Sulfur: World production in all forms by type[1]

(Thousand long tons)

Country[2] and type	1972	1973	1974[p]
Algeria:			
Content of pyrite	13	5	[e]5
Byproduct from petroleum and natural gas[e]	20	20	20
Total	33	25	25
Argentina:			
Native, other than Frasch	42	35	[e]35
Byproduct:			
From metallurgy[e]	[3]6	[3]10	[3]11
From petroleum and natural gas[e]	[3]14	[3]14	[3]14
Total	62	59	60
Australia:			
Content of pyrite	112	115	[e]115
Byproduct:			
From metallurgy	448	427	[e]440
From petroleum[e]	40	42	45
Total	600	584	600
Austria:			
Byproduct:			
From metallurgy	12	[e][4]14	[e][4]15
From spent oxide	[e]1	[e][4]1	[e][4]1
From unspecified sources	6	[3][4]6	[e][4]7
From gypsum	19	[e][4]20	[e][4]26
Total	38	[4]41	[4]49
Belgium; byproduct:			
Recovered elemental, origin unspecified	25	30	30
Recovered other than in elemental form, origin unspecified	184	204	[e]205
Total	209	234	235
Bolivia; native, other than Frasch[5]	18	56	41
Brazil; byproduct from petroleum[6]	9	2	[e]7
Bulgaria:			
Content of pyrite[e]	63	63	64
Byproduct from all sources[e]	110	115	120
Total	173	178	184
Canada:			
Content of pyrite	61	11	22
Byproduct:			
From metallurgy	606	675	712
From natural gas	6,617	7,067	6,838
From petroleum	136	150	160
From tar sands	86	95	95
Total	7,506	7,998	7,827

See footnotes at end of table.

Table 15.—Sulfur: World production in all forms by type[1]—Continued

(Thousand long tons)

Country[2] and type	1972	1973	1974[p]
Chile:[7]			
Native, other than Frasch:			
Refined	16	8	7
Caliche	61	22	24
Byproduct from metallurgy[8]	18	16	23
Total	95	46	54
China, People's Republic of:			
Native, other than Frasch[e]	130	130	130
Content of pyrite[e]	900	900	900
Byproduct from all sources[e]	120	120	120
Total	1,150	1,150	1,150
Colombia:			
Native, other than Frasch	32	27	30
Byproduct from petroleum and natural gas[e]	3	3	3
Total	35	30	33
Cuba; content of pyrite[e]	20	20	20
Cyprus; content of pyrite[9]	273	217	[5] 92
Czechoslovakia:[7]			
Native, other than Frasch	2	5	5
Content of pyrite	122	[e] 120	[e] 110
Byproduct from metallurgy	2	[e] 2	[e] 2
Total	126	127	117
Denmark; byproduct from all sources[e]	6	6	6
Ecuador:			
Native, other than Frasch	6	(10)	--
Byproduct from petroleum and natural gas[e]	1	1	1
Total	7	1	1
Egypt; byproduct from petroleum[e]	1	1	2
Finland:			
Native, other than Frasch	117	121	98
Content of pyrite	379	344	335
Byproduct:			
From lead, copper and zinc metallurgy	91	[e] 93	[e] 93
From other metallurgy	246	237	243
From petroleum	[e] 9	9	[e] 9
Total	842	804	778
France:			
Content of pyrite	13	--	--
Byproduct:			
From natural gas	1,703	1,725	1,811
From petroleum	13	56	[e] [3] 64
From unspecified sources	74	45	[e] [3] 44
Total	1,803	1,826	1,919
Germany, East:[11]			
Content of pyrite[e]	57	57	57
Byproduct from petroleum	87	90	[e] 90
Total	144	147	147
Germany, West:			
Content of pyrite	187	189	[e] 190
Byproduct:			
From petroleum and natural gas	189	301	381
From unspecified sources	502	653	748
Total	878	1,143	1,319
Greece; content of pyrite	178	191	221
Hungary:			
Content of pyrite	3	3	3
Byproduct from all sources	6	9	[e] 10
Total	9	12	13
India:			
Content of pyrite	11	15	13
Byproduct from all sources[e]	136	113	139
Total	147	128	152
Indonesia; native other than Frasch[e] [9]	2	2	2

See footnotes at end of table.

Table 15.—Sulfur: World production in all forms by type[1]—Continued

(Thousand long tons)

Country[2] and type	1972	1973	1974[p]
Iran:			
Native, other than Frasch	3	21	[e] 20
Byproduct from petroleum and natural gas	555	586	595
Total	558	607	615
Iraq:			
Native, Frasch	135	388	700
Byproduct from petroleum and natural gas [e]	108	138	138
Total	243	526	838
Ireland:			
Content of pyrite [e]	31	31	27
Byproduct from all sources [e]	([12])	([12])	([12])
Total	31	31	27
Israel; byproduct from all sources [e]	10	10	10
Italy:			
Native, other than Frasch	90	79	[e] 68
Content of pyrite	612	506	[e] 511
Byproduct:			
From metallurgy	48	[e] 50	[e] 45
From spent oxide	31	[e] 30	[e] 30
From unspecified sources	25	[e] 25	[e] 25
From gypsum	201	[e] 205	[e] 205
Total	1,007	895	[e] 884
Japan:			
Native, other than Frasch	17	[e] 16	[e] 16
Content of pyrite	755	560	616
Byproduct from all sources	1,809	2,147	2,132
Total	2,581	2,723	2,764
Korea, North; content of pyrite [e] [11]	195	195	195
Korea, Republic of; content of pyrite [e]	([12])	([12])	[e] ([12])
Kuwait; byproduct from natural gas and petroleum	54	54	56
Mexico:			
Native:			
Frasch	847	1,583	2,286
Other	21	--	--
Byproduct from natural gas and petroleum [11]	61	63	[e] 64
Total	929	1,646	2,350
Morocco; content of pyrite	131	132	155
Netherlands; byproduct from all sources	44	[e] 41	[e] 45
Netherlands Antilles; byproduct from petroleum	94	80	108
Norway:			
Content of pyrite	363	358	300
Byproduct:			
From metallurgy	20	[e] 22	[e] 19
From petroleum	6	[e] 6	[e] 6
Total	389	386	325
Pakistan; native, other than Frasch [7]	3	3	2
Peru; byproduct from all sources [e]	16	16	16
Philippines; content of pyrite	91	93	[e] 96
Poland:			
Native:			
Frasch	2,339	2,928	3,659
Other than Frasch	541	561	369
Byproduct:			
From petroleum	230	235	258
From other sources	15	17	18
Total	3,125	3,741	4,304
Portugal:			
Content of pyrite	239	231	221
Byproduct from all sources	3	[e] 3	[e] 3
Total	242	234	224
Rhodesia, Southern; content of pyrite [e]	30	30	30

See footnotes at end of table.

Table 15.—Sulfur: World production in all forms by type [1]—Continued

(Thousand long tons)

Country [2] and type	1972	1973	1974 [p]
Romania:			
Content of pyrite [e]	355	370	370
Byproduct from all sources	[e] 6	[e] 6	[e] 6
Total	361	[e] 376	[e] 376
Saudi Arabia; byproduct from natural gas [e]	5	5	5
Singapore; byproduct from petroleum	6	[e] 6	[e] 6
South Africa, Republic of:			
Content of pyrite	173	217	201
Byproduct from all sources	133	88	121
Total	306	305	322
South West Africa, Territory of; content of pyrite	--	5	4
Spain:			
Content of pyrite	985	1,111	1,187
Byproduct:			
From metallurgy	102	[e] 110	[e] 110
From petroleum	3	2	[e] 2
From lignite gasification	1	1	[e] 1
Total	1,091	1,224	1,300
Sweden:			
Content of pyrite	246	228	226
Byproduct:			
From metallurgy	118	[e] 120	[e] 120
From other sources	3	[e] 5	[e] 5
Total	367	353	351
Switzerland: byproduct from all sources [e]	2	2	2
Syria; byproduct from petroleum and natural gas [e]	7	8	8
Taiwan:			
Native, other than Frasch	4	6	3
Content of pyrite	11	4	4
Byproduct from all sources [e]	2	2	2
Total	17	12	9
Thailand; byproduct from all sources [e]	1	1	1
Trinidad and Tobago; byproduct from petroleum	[e] 40	42	[e] 42
Turkey:			
Native, other than Frasch	21	17	[e] 18
Content of pyrite	35	20	[e] 20
Byproduct from all sources [e]	29	29	29
Total	85	66	67
U.S.S.R.:			
Native, other than Frasch [e]	2,165	2,260	2,360
Content of pyrite [e]	3,500	3,800	3,900
Byproduct from all sources [e]	1,670	1,820	1,870
Total	7,335	7,880	8,130
United Kingdom:			
Byproduct:			
From metallurgy	40	57	[e] 59
From spent oxide	40	28	[e] 30
From unspecified sources	18	13	[e] 12
From gypsum	153	80	[e] 79
Total	251	178	180
United States:			
Native, Frasch	7,290	7,605	7,901
Content of pyrite	283	212	162
Byproduct:			
From metallurgy	546	600	654
From natural gas	819	1,039	1,211
From petroleum	1,131	1,377	1,421
Other [13]	149	88	70
Total	10,218	10,921	11,419
Uruguay; byproduct from petroleum	(12)	(12)	(12)
Venezuela; byproduct from petroleum and natural gas [e]	80	80	80

See footnotes at end of table.

Table 15.—Sulfur: World production in all forms by type[1]—Continued

(Thousand long tons)

Country[2] and type	1972	1973	1974 p
Yugoslavia:			
Content of pyrite	95	90	105
Byproduct:			
From metallurgy	248	255	222
From petroleum	4	5	4
Total	347	350	331
Zaire; byproduct from metallurgy e	50	50	50
Zambia:			
Content of pyrite	e 30	30	e 30
Byproduct from all sources e	40	45	50
Total	70	75	80
Grand total	44,776	48,410	50,861
Of which:			
Native:			
Frasch	10,611	12,504	14,546
Other than Frasch	3,291	3,369	3,228
Content of pyrite	10,552	10,473	10,507
Byproduct:			
From metallurgy	2,601	2,738	2,818
From natural gas	9,144	9,836	9,865
From petroleum	1,809	2,103	2,224
From tar sands	86	95	95
From petroleum and natural gas, undifferentiated	1,092	1,268	1,360
From spent oxide	72	59	61
From unspecified sources	5,145	5,660	5,847
From gypsum	373	305	310

e Estimate. p Preliminary.

[1] The format of this table has been revised so as to include all recorded production of sulfur from mineral materials regardless of its origin or the form in which it is recovered. Thus, the sulfur content of pyrite, previously recorded in a separate table in this chapter, is included here (gross weight of pyrite is reported in table 16 of this chapter to continue the historical series). Similarly, for the first time the sulfur content of sulfuric acid produced directly from mineral materials other than pyrite without prior processing to elemental sulfur has been included where such data are available, or where a reasonable basis for estimation is available. Totals for each country have not been indicated as estimates even where all components of the total are estimates. The user is cautioned that any country total represents simply the summation of the detail for that country, including such estimates as may appear in the detail unless the total has been footnoted to the contrary. Because of the revisions in the format of this table, no figures have been indicated as being revised, although they may differ from figures appearing in tables 16 and/or 17 of the 1973 edition of this chapter.

[2] In addition to the countries listed, a number of nations refining oil and processing nonferrous metals may produce sulfur, but such output is regarded as small, and is largely if not entirely consumed by the producer.

[3] Detail has been estimated on the basis of a reported total for byproduct production.

[4] Detail has been estimated on the basis of a reported total for all sulfur.

[5] Exports, regarded as virtually equivalent to production, owing to minimal domestic consumption.

[6] Brazil and Egypt may also produce sulfur from metallurgical operations and/or from natural gas, but output is not reported quantitatively and no reliable basis is available for formulation of output level estimates.

[7] Chile, Czechoslovakia, and Pakistan may also produce sulfur from natural gas and/or petroleum, but output is not reported quantitatively and no reliable basis is available for formulation of output level estimates.

[8] Includes a small output from byproduct pyrite.

[9] Cyprus, Indonesia, and the Republic of Korea may also produce sulfur from petroleum refining, but output is not reported quantitatively and no reliable basis is available for formulation of output level estimates.

[10] Revised to zero.

[11] East Germany, North Korea, and Mexico may also produce sulfur from metallurgical operations but output is not reported quantitatively and no reliable basis is available for formulation of output level estimates.

[12] Less than ½ unit.

[13] Sulfur content of H_2S gas and liquid SO_2 not included elsewhere.

Table 16.—World production of pyrites[1]
(Gross weight, thousand long tons)

Country[2]	1972	1973	1974 p
North America:			
Canada	112	23	44
Cuba e	50	50	50
United States[3]	741	559	424
Europe:			
Bulgaria e	150	150	150
Czechoslovakia e	r 295	r 285	260
Finland	843	765	710
France	33	--	--
Germany, East e	140	140	140
Germany, West	415	421	e 425
Greece	r 397	423	490
Hungary e	7	7	7
Ireland	65	e 65	56
Italy	1,361	1,151	e 1,160
Norway	r 791	780	654
Portugal	544	524	503
Romania e	830	860	867
Spain	2,106	2,363	2,559
Sweden	479	443	e 443
U.S.S.R. e	r 7,500	r 8,100	8,400
Yugoslavia	227	213	251
Africa:			
Algeria	27	12	e 12
Morocco	423	401	501
Rhodesia, Southern e	72	72	74
South Africa, Republic of	432	542	503
South-West Africa, Territory of	--	12	9
Zambia e	75	75	75
Asia:			
China, People's Republic of e	2,000	2,000	2,000
Cyprus	r 561	462	[4] 300
India	30	41	35
Japan	1,555	1,255	1,265
Korea, North e	500	500	500
Korea, Republic of	1	1	e 1
Philippines	r 196	200	e 207
Taiwan	30	11	10
Turkey	76	43	e 43
Oceania: Australia	r 240	241	e 240
Total	r 23,304	23,190	23,368

e Estimate. p Preliminary. r Revised.

[1] Data on sulfur content of pyrite, included in this table in previous editions of this chapter, have been reported with data on production of other forms of sulfur in table 15.

[2] In addition to the countries listed, Chile produces a small quantity of byproduct pyrite. The sulfur content of this pyrite is included in table 15 but no basis is available for determining the gross weight of this material.

[3] Sold or used by producers.

[4] Exports.

TECHNOLOGY

Sulfur technology advanced on several fronts during the year. Elemental sulfur recovery from new sources was investigated, new environmental problems were recognized, the controversy over stack gas scrubbing was narrowed down, and recovery of sulfur from coal came closer to realization. Additionally, basic research on sulfur and sulfur compounds was expanded, and new use applications were emerging from laboratories.

Future elemental sulfur supplies will come in part from sources not now contributing. One example was the continuing development of a process, by the College Park Metallurgy Research Center of the Bureau of Mines in Maryland, to smelt chalcopyrite in a manner in which all the sulfur is converted to the elemental form, thus eliminating stack gas emission of SO_2. The first and unique step in the process is to convert the chalcopyrite to a sulfur-deficient form by inert-atmosphere roasting. The iron is then leached before dissolving and electrowinning the copper. Elemental sulfur is recovered in both the roast and the leach steps.[16]

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[16] U.S. Bureau of Mines. Mineral Research and Data Analysis Highlights. V. 1, No. 3, November 1974, p. 10.

Attention was diverted from the possible environmental effects of dilute SO_2 concentrations in the atmosphere to the problem of sulfates, as salts or as sulfuric acid, resulting from the oxidation of SO_2. The normal pH of rain in equilibrium with prevailing carbon dioxide concentrations is about 5.7. Much stronger acids have, however, been observed recently in the Northeastern United States, with pH values as low as 2.1 and averaging between 3 and 4. Records of pH are scarce prior to about 1963, but indications are that the pH was higher at that time. Nevertheless the sulfur content of rain and snow in New York State, as one example, has declined by 70% since 1950. This phenomenon of "acid rain" was attributed to lack of basic particulates in stack gas emissions, due principally to the use of cleaner fuels such as natural gas and oil but also to the removal of the particulates in gases from coal-fired boilers and furnaces. In two series of tests, it was reported that $SO_4{}^{2-}$ represented about 60% of the anions present in the acid rain, $NO_3{}^-$ about 22%, and Cl^- about 15%.[17] The phenomenon was considered all the more disturbing because it implicated the cleanest fuels in use today. Carried to its logical conclusion, it would require coal cleaning and conversion and stack gas scrubbing beyond what appear to be economic limits.

The acid rain problem was also perveived as a brake on use of tall stacks and intermittent emission controls. The Environmental Protection Agency (EPA) contended in numerous actions that a positive reduction of sulfur oxide emissions must be achieved, and that mere maintenance of ambient air quality does not meet the spirit of the Clean Air Act. The Tennessee Valley Authority (TVA), on the other hand, continued with plans to attain compliance with ambient SO_2 standards by intermittent controls (switching fuels or curtailing power production to maintain air quality) and the use of tall stacks. Following a decision in 1973, TVA continued with plans to extend the intermittent control-tall stack solution to 9 of its 12 coal-fired generating stations; the 3 remaining stations will meet ambient standards without further control by 1975.[18]

Sulfate emissions from automobiles were also credited with a contribution to atmospheric pollution. Evidence was found that the catalytic converters attached to automobile exhaust systems oxidize sulfur dioxide to sulfates, as well as performing their primary function of oxidizing hydrocarbon emissions. The EPA was to study the specific sulfate species emitted and their relationship to health, especially on a localized basis. Additional desulfurization by hydrotreating catalytic feedstock to refineries was to be studied.[19]

By yearend 1974, 20 stack gas scrubbers, chiefly using lime-limestone technology, had been built, and 15 more were under construction. Nevertheless, litigation continued to cloud future developments.

The Pennsylvania Commonwealth Court upheld a lower court opinion that emission control technology was not commercially available for the removal of sulfur oxides from stack gases of electrical generating plants.[20]

In a case brought in 1974 by Commonwealth Edison of Illinois against the Illinois Pollution Control Board, a State appellate court, early in 1975, ruled that data presented so far by the Control Board failed to establish either the technological or economic feasibility of sulfur removal from stack gases by the five technologies cited by the Board: Dry limestone injection, wet lime scrubbing, magnesium oxide scrubbing, catalytic conversion of SO_2 to SO_3, and fuel desulfurization. The fine levied by the Control Board was set aside by the Court.[21]

Prospects for compliance with provisions of the Clean Air Act of 1970 by electric utilities were diminished by differences of opinion between the utilities and EPA. The Clean Air Act required compliance by June 1975 with State plans implementing a national primary ambient air quality standard. In June 1974, EPA served violation notices with possible penalties on the Central Illinois Light Co. This was called the beginning of a "major effort" to force compliance with emissions standards. The EPA later proposed regulations allowing a State to designate areas in three classifications: (1) No significant increase in air pollution required, (2) moderate degradation permitted, and (3) pollution allowed to rise to national standard.[22] Power companies, led by the American Electric Power Co., Inc., alleged in numerous public statements that stack gas scrubbing has not been proved effective, reliable, or justifiable, and would create a sludge disposal problem of large proportions.

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[17] Likens, G. E., and F. H. Bormann. Acid Rain: A Serious Regional Environmental Problem. Science, v. 184, No. 4142, June 14, 1975, pp. 1176–1179.

[18] Montgomery, T. L. and J. W. Frey. Tall Stacks and Intermittent Control of SO_2 Emissions—TVA Experience and Plans. Min. Cong. J., v. 61, No. 1, January 1975, pp. 44–51.

[19] Iammartino, N. R. A Sulfur in Gasoline Scare? Chem. Eng., v. 81, No. 26, Dec. 9, 1974, pp. 74, 76, 78.

[20] Coal Mining and Processing. V. 11, No. 5, May 1974, p. 26.

[21] Chemical Engineering. V. 82, No. 2, Jan. 20, 1975, pp. 42–43.

The Bureau of Mines issued a study of the sludge disposal problem. It was concluded that electric power industry adoption of lime or limestone postcombustion desulfurization systems may create a solid waste disposal problem and possibly contribute to water pollution. The estimated lime or limestone desulfurization capacity in 1980 of 86,000 megawatts, operating for 20 years, will generate enough solid waste (50% solids) to cover about 58 square miles to a depth of 20 feet. Toxic elements originating in the lime or limestone, coal, or fly ash may accumulate in the sluice water in a closed-loop operation. The magnesium present in dolomitic limestone might render it unusable because the magnesium sulfate formed is very soluble.[23] Such considerations indicated that either a use should be found for the sludge, as in roadbuilding or construction, or alternative processes that produce a less bulky, more easily handled, and more valuable product should be considered. The chief processes answering to this description are those that yield elemental sulfur from stack gas scrubbing.

The solubility of certain sludge constituents and the difficulty of consolidating the sludge were expected to be alleviated to a great extent at the new Bruce Mansfield power station at Shippingport, Pa. The pH of the slurry will be raised to about 11 with slaked lime, and a special additive, known as Calcilox, will be added. The sludge is expected to harden at the disposal dam to a material that will support a weight of 4.5 tons per square foot.[24]

Phase 1 of the pilot program to test the Bureau of Mines citrate process, which yields elemental sulfur as a final product, was put into operation at the Bunker Hill smelter in Kellogg, Idaho, in February 1974. This phase included only absorption of the sulfur oxides of the stack gases in the citrate solution and precipitation of elemental sulfur by injection of hydrogen sulfide into the solution. Several extended periods of successful operation were achieved during the year. Phase 2, the gas cooling and cleaning section that precedes the citrate section, and phase 3, the section to generate hydrogen sulfide from the elemental sulfur product and a fuel, such as natural gas, were due to be constructed and operating early in 1975. In laboratory investigations it was found that glycolate solutions may be advantageously substituted for citrate solutions. A further advance was the discovery that the elemental sulfur product could be floated with fine bubbles of injected air, without the necessity to add kerosine as a collector; this would improve the quality of the sulfur product and effect a cost saving.[25]

An announcement of the Bureau plan for demonstrating the citrate process at coal- or oil-fired steam-generating facilities equivalent to 30- to 60-watt generating capacity was made on August 12, 1974, in the Commerce Business Daily. A Request for Proposal (RFP) was issued on November 8, 1974. Proposals in response were received early in 1975 and were to be evaluated.[26] In a later development, emphasis was to be placed on coal-fired facilities.

The developing energy crisis focused attention on coal as the only available fuel to replace dwindling supplies of petroleum and natural gas; there was a unanimous opinion among technologists that nuclear, solar, geothermal, and oil shale energy would contribute only small increases to the Nation's energy supply by 1985. The problem of utilizing coal in an environmentally acceptable manner was very largely one of sulfur control and removal to maintain and improve air quality. A place was seen for numerous competing technologies to attain this objective, depending on local conditions at the point of energy delivery; besides stack gas scrubbing, other technologies, including coal cleaning by physical or chemical means and conversion of coal to clean (sulfur and ash free) gaseous, liquid, and solid fuels, were the object of intense and broad research. Many of these processes produced sulfur in reduced forms.

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[22] Chemical Week. V. 115, No. 9, Aug. 28, 1974, p. 13.

[23] Evans, R. J. Potential Solid Waste Generation and Disposal From Lime and Limestone Desulfurization Processes. BuMines IC 8633, 1974, 22 pp.

[24] Chemical Week. A Dam Good Solution for Sludge Disposal. V. 115, No. 21, Nov. 20, 1974, p. 67.

[25] U.S. Bureau of Mines, Division of Metallurgy Research, Salt Lake City, Utah, Annual Report. Fiscal Year 1975, p. 1.

[26] Page 68 of work cited in footnote 25.

The Office of Coal Research of the U.S. Department of the Interior, with a greatly increased budget, accelerated its sponsoring of work in all areas of coal conversion technology and clean direct combustion.[37] A number of large industrial firms also devoted increased funds to efforts to desulfurize coal.

The pilot plant at Ft. Lewis, Wash., to demonstrate the solvent refining of coal (SRC) was started in October 1974, after being held up by delays in construction, and full operation was expected early in 1975. The process, in which coal is dissolved in a process-derived heavy aromatic solvent, yields a solid product, after filtering and solvent removal, containing 0.8% sulfur; all the inorganic and 60% to 70% of the organic sulfur is removed. A study was being prepared for publication under an interagency agreement with the EPA on aspects of sulfur and nitrogen removal from the SRC product.

A pilot-scale multicell fluidized-bed boiler (MFB) was operated by Pope, Evans, & Robbins Inc., in Alexandria, Va. The MFB uses a fluidized bed of calcium oxide added in the form of limestone or dolomite. A unit is being designed as a 30-megawatt module for boilers in the 60- to 800-megawatt range. Sulfur in the pulverized coal feed is retained in the bed during combustion, and a portion of the bed is continuously withdrawn; studies are underway to regenerate the calcium sulfate formed in the bed to yield CaO for recycle and SO_2 that can be used to make sulfuric acid. Tests showed that 90% of the sulfur in a ton of 4.1% sulfur coal can be removed by 550 pounds of low-quality limestone, with 48 pounds of common salt as a catalyst. Field erection of a 30-megawatt unit was started at the plant of the Monongahela Power Company at Rivesville, W. Va. It was claimed that annualized costs of such a boiler would be 35% below those of limestone scrubbers on the stack gas, and overall operating efficiency of the powerplant would be 39%, compared with approximately 35% for the stack gas cleanup route.

A major step in ultimate production of clean fuels from coal was taken by the Office of Coal Research when it released, on June 23, 1974, an RFP for a demonstration plant to produce clean boiler fuel from coal. Three proposals were received in 1974, and early in 1975 it was announced that the Coalcon Co. of New York had been awarded a contract for a plant to process 2,600 tons per day by pyrolysis in the presence of hydrogen at modest total pressure. Both liquid and gaseous products were to be produced, as well as a char that can be used to generate hydrogen. The plant was to be designed to operate mainly on high-sulfur eastern bituminous coal, and will produce substantial quantities of elemental sulfur.

In the search for an effective and economic solution to the apparent SO_2 emission dilemma, namely that the cost of effective, reliable control systems may ultimately prove very high although there is no dispute over the necessity to control local emissions, a number of processes that promise cost reductions were advanced during the year. Two systems for removing sulfur from coal were included. Battelle Memorial Institute tested an alkaline leach of finely ground coal, which it was said would remove 99% of the pyritic sulfur and up to 70% of the organic sulfur, largely as elemental sulfur. Kennecott Copper Corp.'s Ledgemont Laboratory also was successful in experimental work on oxidizing the pyritic sulfur in coal with oxygen. Both the Battelle and the Kennecott processes were stated to be effective under moderate conditions of temperature and pressure. It appeared at yearend that removal of much of the sulfur from coal by chemical, or even by physical, means might be accomplished without dissolving the coal, and the resulting fuel, if used in connection with tall stacks, might meet environmental standards. The relationship of this possibility to the new-found problem of acid rain, which it would not alleviate but which the Clean Air Act does not consider, remained for future investigation.

Research programs, designed not only to develop new uses for sulfur but to investigate its basic properties, were expanded in 1974. These projects were sponsored by Government agencies, trade organizations, sulfur producing companies, unversities, and independent laboratories. They were originally initiated because of a continuing oversupply of sulfur that lowered sulfur prices to a critical level for the sulfur producing industries. Additionally, it was anticipated that stricter enforcement of environmental regulations would lead to a rapid upsurge in the production of byproduct sulfur at environmental-related source points, with a further worsening of the oversupply and price positions. While the original intent of the research was to alleviate these situations, it became apparent as investigations continued that many of the proposed new uses showed promise of being of inherent value, independent of such considerations.

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[37] U.S. Office of Coal Research. Shaping Coal's Future Through Technology. Annual Report 1974–75, 243 pp.

The American Chemical Society sponsored a symposium on April 2–3, 1974, for the purpose of reviewing the major research advances in the field of new sulfur uses. Fourteen published presentations covered plasticization of sulfur, sulfur-coated urea, sulfur coatings, sulfur in structural and construction materials, sulfur-asphalt pavements, sulfur-asphalt binders for roads, civil engineering applications of sulfur-based materials, cold region testing of sulfur foams and coatings, polyphenylene sulfide, lithium-sulfur cells, metal sulfide electrodes for secondary lithium batteries, and sodium-sulfur batteries.[28]

Academic research on the basic chemistry of sulfur and sulfur compounds was expanded in 1974. In depth studies of this type were being carried on by investigators at 363 universities and technical institutes in 40 countries.[29]

The Bureau of Mines continued its broadly based sulfur utilization research program. One segment of research covered the use of sulfur in coatings and structural materials.[30] Another phase of research investigated the use of sulfur as a construction material.[31] A third sector of the research was concerned with the use of sulfur for pollution abatement.[32] A major portion of the Bureau's research program was devoted to an investigation of the beneficial use of sulfur in sulfur-asphalt pavements. A substantial part of this particular research was conducted by the Texas A & M Research Foundation under a contract that was jointly funded by the Bureau of Mines and The Sulphur Institute.[33]

The Sulphur Development Institute of Canada continued to sponsor large-scale research programs designed to develop new uses for sulfur. Major phases of research included the development of sulfur foams as an insulating material under highways in cold climates, sulfur-asphalt compositions for highway pavement, and sulfur concretes for construction purposes. Financing was being provided by the Federal Government of Canada, the Provincial Government of Alberta, and recovered sulfur producers in Alberta.

An area of sulfur research that has shown a considerable promise of success has been the substitution of sulfur for a substantial portion of the asphalt in conventional asphaltic pavements. A number of investigators in the United States, Canada, and France have been independently pursuing this line of research. Their efforts have been largely prompted by an increasing shortage of asphalt and a rapid escalation in the cost of this product. It was estimated that annual savings of 10 to 26 million barrels of petroleum could be achieved in the United States through the partial substitution of sulfur for asphalt in road construction projects.[34] Additionally, research in progress has indicated a possible improvement in pavement characteristics.

Another promising major new use for sulfur was as an essential plant nutrient. Investigations have indicated that the amount of sulfur added to crops in the form of fertilizers was insufficient to meet the requirement for this element. It was estimated that the U.S. requirement was 2.5 to 4.0 million tons per year, whereas only about 1.0 million tons was actually being applied as a fertilizer ingredient.[35]

Use of sulfur in new energy sources was foreshadowed by development of the Solchem process by the Naval Research Laboratory, Washington, D.C. Reversible endothermic-exothermic reactions involving SO_3 and SO_2 are utilized to absorb heat in a solar reaction and deliver it to a heat exchanger.[36]

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[28] West, J. R. (ed). New Uses of Sulfur. Advances in Chemistry Series 140 (American Chemical Society), 1975, 236 pp.

[29] Fike, H., and C. Rixon. Current Academic Research in Sulphur Chemistry—1974. Sulphur Institute, May 1974, 69 pp.

[30] Pages 55–74 of work cited in footnote 28.

[31] Pages 75–84 of work cited in footnote 28.

[32] Sullivan, T. A., and W. C. McBee. Sulfur Utilization in Pollution Abatement. Proc. 4th Mineral Waste Utilization Symp. sponsored by BuMines and IIT Res. Inst., Chicago, Ill., May 7–8, 1974, pp. 246–251.

[33] Pages 102–129 of work cited in footnote 28.

[34] Federal Highway Administration. Press Release FHWA 28–75, Apr. 3, 1975, 2 pp.

[35] Beaton, J. D., D. W. Bixby, S. L. Tisdale, and J. S. Platou. Fertilizer Sulfur Status and Potential in the US. Sulphur Institute, Tech. Bull. 21, August 1974, 18 pp.

[36] Chemical and Engineering News. SO_3 Dissociation Keys Solar Energy System. V. 51, No. 31, Aug. 5, 1974, p. 21.

Talc, Soapstone and Pyrophyllite

By J. Robert Wells [1]

Demand for the various types of industrial talc continued strong in 1974, and producers mostly operated at or near capacity throughout the year.

International Talc Co., Inc., prominent in the list of U.S. producers for more than 75 years, sold in May 1974, its mining and processing facilities in St. Lawrence County, N.Y. to R. T. Vanderbilt Co., Inc. (formerly of New York City, recently relocated in Norwalk, Conn.). Operation of the transferred properties is being continued by Vanderbilt's subsidiary, Gouverneur Talc Company, Inc., the other major producer in that same area.

One of the largest talc producers in the United States, the United Sierra Division of Cyprus Mines Corp., recorded a number of notable changes in 1974. The firm name was changed to Cyprus Industrial Minerals Co.; the headquarters office was transferred from Trenton, N.J., to Los Angeles, Calif.; and a $2.2-million expansion of the company's talc grinding facilities at Three Forks, Gallatin County, Mont., was undertaken to make it possible to increase by 50% the output from the Yellowstone mine in adjacent Madison County.

American Lava Corp., a subsidiary of Minnesota Mining & Manufacturing Co. (3M Company) and long established as a prominent maker of steatite ceramics, was reorganized in 1974 to form one completely new division, Technical Ceramic Products, and part of a second, the Electronic Products department, both to be listed as units of 3M's Electrical Products group. It was announced that the facilities of the former American Lava Corp., in both Chattanooga, Tenn. and Laurens, S.C., will be operated without interruption by the new Technical Ceramic Products division to continue Lava's manufacturing of specialty ceramics.

Although the compositional and genetic relationships between talc and some of the minerals generally classified as asbestos continued to be cited by some writers in 1974 to raise questions concerning talc's possible complicity in human gastric and pulmonary disorders, there was no decisive evidence for concluding that there had been any material restriction of talc production and consumption on that account.

Talc was explicitly excluded from consideration in a clarifying revision interpreting the provisions of emission standards issued by the Environmental Protection Agency for asbestos, beryllium, and mercury. The statement was made that ". . . talc mines were not covered by the proposed standards; this was also intended to indicate that manufacturing operations that use talc or other materials contaminated with asbestos were not covered by the asbestos standard. In addition, the information available to the Agency at the time of promulgation (April 6, 1973) did not demonstrate that the mining and milling of such substances were major sources of asbestos emissions." It was further stated that "The Department of the Interior and the Department of Health, Education, and Welfare are studying the health effects of asbestos in talc." [2]

Legislation and Government Programs.—Defense materials inventories of the General Services Administration showed that Government holdings as of December 31, 1974, included 1,149 short tons of talc (steatite, block or lump) purchased in compliance with a stockpile objective, and 2,916 short tons of talc (steatite, ground) acquired in nonstockpile transactions.

The Office of Minerals Exploration,

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[1] Physical scientist, Division of Nonmetallic Minerals.

[2] U.S. Code of Federal Regulations. Title 40—Protection of Environment; Chapter 1—Environmental Protection Agency; Subchapter C—Air Programs; Part 61—National Emission Standards for Hazardous Air Pollutants. Federal Register, v. 39, No. 87, May 3, 1974, pp. 15396–15398.

Geological Survey, offered to grant loans of up to 50% of approved exploration costs for eligible deposits of block steatite talc, but no loans for that purpose were made in 1974. The allowable depletion rates for talc, established by the Tax Reform Act of 1969 and unchanged through 1974, were 22% on production of block steatite talc of domestic origin and 14% on foreign production of the same material; the same rate applied also to production of all other classes of talc from all sources.

Table 1.—Salient talc, soapstone, and pyrophyllite statistics
(Thousand short tons and thousand dollars)

	1970	1971	1972	1973	1974
United States:					
Mine production	1,028	1,037	1,107	1,247	1,268
Value	$7,773	$7,634	[r] $7,835	$9,144	$11,099
Sold by producers	948	979	1,084	1,184	1,064
Value	$25,980	$26,936	$33,709	$32,226	$32,599
Exports [1]	105	136	171	180	183
Value	$5,739	$4,844	$5,791	$6,618	$6,711
Imports for consumption	30	17	29	23	30
Value	$1,294	$745	$1,669	$1,658	$2,233
Apparent consumption	873	860	942	1,027	911
World: Production	[r] 5,387	5,221	[r] 5,324	[r] 5,808	6,023

[r] Revised.
[1] Excludes powders—talcum (in package), face, and compact.

A report was issued early in 1974 in which were published the papers presented at the conference on industrial hygiene of talc that was sponsored by the U.S. Department of the Interior in 1973.[3] A subsequent communication, dated December 4, 1974, and addressed to recipients of that report, contained the following statement:

"There is an erratum in the presentation by Dr. Schepers on page 69. The last sentence of the first full paragraph on this page should read:

> "Excess prevalence of lung cancer, which could not equally reasonably have been accounted for in terms of exposure to cigarette smoke, urban pollution or to prior, concurrent, or sequential exposure to true asbestos, has *never* been convincingly recorded."

The word "never" had been omitted in the original printing, completely reversing the intended significance of the passage.

DOMESTIC PRODUCTION

Mine production of crude talc and related minerals in the United States established new records in 1974 in both tonnage and total value, topping by 2% and 21%, respectively, the previous highs reached in 1973.

Talc-group minerals were produced from a total of 53 mines distributed throughout 14 States. Talc or soapstone was mined at one or more locations in each of those States; domestic production of pyrophyllite was limited, as in 1973, to the output of just five mines, all in North Carolina. The six leaders among the talc-group producing States (New York, Montana, Vermont, Texas, California, and North Carolina, ranked in descending order by tonnage—Vermont, Montana, New York, California, Texas, and North Carolina, ranked by value) jointly supplied 96% of the 1974 total domestic output. New York, the foremost producing State throughout most of the industry's history, remained in first place with regard to total production, but slipped in 1974 to third place in terms of value.

The 10 largest domestic producers of talc-minerals in 1974, listed alphabetically, were Cyprus Industrial Minerals Co., with mines in California, Montana, and Texas; Eastern Magnesia Talc Co. in Vermont; Johns-Manville Corp. (successor to L. Grantham Corp.) in California; Pfizer Inc., Minerals, Pigments & Metals Div. in California and Montana; Piedmont Minerals Co., Inc in North Carolina; Southern Clay Products, Inc., in Texas; R. T. Vanderbilt Co., Inc., in California, New York, and North Carolina; Westex Talc Co. in Texas; and Windsor Minerals, Inc., in Vermont. Those firms supplied 90% of the 1974 tonnage (93% of the total value), and the combined output of about 21 smaller producers made up the remainder.

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[3] Goodwin, A. (comp. by). Proceedings of the Symposium on Talc, Washington, D.C., May 8, 1973. BuMines IC 8639, 1974, 102 pp.

Talc minerals were ground for sale or industrial use in 1974 at 35 mills operated by 29 companies in 11 States. Talc or soapstone mined in Nevada and Washington was shipped to other States for grinding, and talc from outside sources was ground in Nebraska, where there was no mine production.

Noteworthy among 1974 events in the talc industry were the continuing major expansions, especially of ultrafine-grinding facilities, on the part of several important producers in the western United States.

Table 2.—Talc, soapstone, and pyrophyllite produced in the United States, by State

State	1973 Quantity (short tons)	1973 Value (thousands)	1974 Quantity (short tons)	1974 Value (thousands)
California	179,191	$1,501	166,538	$1,698
Georgia	38,000	114	33,850	102
North Carolina	95,833	1,094	110,978	993
Texas	232,514	1,246	192,492	1,310
Vermont	251,087	1,497	238,180	3,251
Virginia	4,600	12	W	W
Other States[1]	445,309	r 3,680	525,595	3,745
Total	1,246,534	9,144	1,267,633	11,099

r Revised. W Withheld to avoid disclosing individual company confidential data; included with "Other States."

[1] Includes Alabama, Arkansas, Maryland, Montana, Nevada, New York, Oregon, Pennsylvania (1973), Virginia (1974), and Washington.

Table 3.—Talc, soapstone, and pyrophyllite sold or used by producers in the United States, by class

(Thousand short tons and thousand dollars)

Year	Crude Quantity	Crude Value	Ground Quantity	Ground Value	Total Quantity	Total Value
1970	96	572	852	25,407	948	[1]25,980
1971	132	789	847	26,147	979	26,936
1972	90	521	994	33,188	1,084	33,709
1973	118	918	1,066	31,308	1,184	32,226
1974	114	1,294	950	31,305	1,064	32,599

[1] Data do not add to total shown because of independent rounding.

CONSUMPTION AND USES

Apparent domestic consumption of crude and ground talc, soapstone, and pyrophyllite (total sales plus imports minus exports) declined 11% to 911,000 tons from the first 1 million tons per year recorded in 1973. Reported 1974 sales of ground material were 11% less in tonnage than in 1973, but the average unit value increased $3.58, and the total value was unchanged from that of 1973. Approximately 21% of the total quantity of talc-group minerals sold or used by domestic producers in 1974 were consumed in the manufacture of ceramics, 15% was used in paint, and another 17% was exported.

The 1974 end-use distribution showed

an 11% increase in talc utilized for papermaking. This usage accounted for 8% of the total in 1974, compared with 5% and 7% in each of the 2 preceding years. It is no doubt significant in this regard that a number of talc processors in the western United States were pushing up their capacity to supply the ultrafine grades of material especially required by pulp and paper manufacturers for pitch control.

Table 4.—Pyrophyllite produced and sold by producers in the United States

Year	Production	Sales	
	Short tons	Short tons	Value (thousands)
1970	[1] 120,077	95,735	$1,317
1971	101,030	90,477	1,155
1972	W	90,482	1,236
1973	W	113,019	1,469
1974	105,703	101,182	1,474

W Withheld to avoid disclosing individual company confidential data.

[1] Includes sericite schist.

Table 5.—Talc, soapstone, and pyrophyllite sold or used by producers in the United States, by use

(Short tons)

Use	1973	1974
Asphalt filler	13,039	12,186
Ceramics	346,254	221,365
Exports	180,102	182,706
Insecticides	43,404	47,088
Paint	178,352	157,792
Paper	79,995	88,519
Refractories	54,384	32,220
Roofing	30,557	45,867
Rubber	31,646	25,123
Textiles	8,193	14,428
Toilet preparations	40,006	34,628
Other uses [1]	178,546	202,163
Total	1,184,478	1,064,085

[1] Includes art sculpture, crayons, floor tile, foundry facings, plastics, rice polishing, stucco, and other uses.

STOCKS

According to estimates based on data reported by producers, the total quantity of crude, ground, and partly processed talc on hand in the United States (that is, mined but not yet sold or used) was approximately 225,000 tons on December 31, 1974, compared with 157,000 tons on that date in 1973.

PRICES

Engineering and Mining Journal, December 1974, quoted prices for domestic ground talc in carload lots, f.o.b. mine or mill, containers included, per short ton, as follows:

Vermont:	
98% through 325 mesh, bulk	$23.00
99.99% through 325 mesh, bags:	
Dry processed	67.00
Water beneficiated	92.00
New York:	
96% through 200 mesh	$31.00–32.00
99.9% through 325 mesh	40.00–50.00
100% through 325 mesh, fluid-energy ground	50.00–90.00
California:	
Standard	58.50
Fractionated	37.00–71.00
Micronized	62.00–104.00
Cosmetic-steatite	44.00–65.00
Georgia:	
98% through 200 mesh	14.00
99% through 325 mesh	25.00
100% through 325 mesh, fluid-energy ground	75.00

American Paint & Coatings Journal, December 30, 1974, listed the following prices per ton for paint-grade talcs in carload lots:

California:	
325 mesh, bags, mill:	
Fibrous, white, high oil absorption	$34.00–$37.00
Semifibrous, medium oil absorption	32.00–73.95
Montana:	
Ultrafine grind, f.o.b. mill	70.00
New York:	
Fibrous and semifibrous, bags, mill:	41.50–45.50
98% through 325 mesh	49.50
99.4% through 325 mesh	85.00–95.00
Fine micron talcs (origin not specified)	68.00–111.50

The price range quoted in Chemical Marketing Reporter, December 30, 1974, for carload lots of imported Canadian talc, ground, in bags, was from $20 to $35 per ton, f.o.b. works.

The equivalent in dollars per short ton of price ranges for steatite talc, c.i.f. main European port, quoted by Industrial Minerals (London), December 1974, were approximately as follows:

Norwegian:	
Ground (ex store)	$63.00-$70.00
Micronized (ex store)	98.00-159.00
Chinese:	109.00-123.00

No explanation was offered for the fact that these quotations were approximately double those appearing in the same magazine, January through July 1974.

FOREIGN TRADE

Exports.—The quantity of talc-group minerals exported from the United States in 1974 was 2% more than in 1973, and the total value was 1% higher, establishing new alltime highs for both. The largest share of the exported material was shipped to Mexico, followed in descending order by Canada and Belgium; shipments to those three countries accounted for 80% of the 1974 total, and the remaining 12% was distributed among about 50 other countries.

Imports.—Almost one-third more talc in unmanufactured form was imported by the United States in 1974 than in 1973, whether estimated by quantity or by total value. Total value of U.S. imports in the Census Bureau's classification "Talc, steatite, and soapstone and articles of these, not specially provided for" approached $250,000 for the second year in succession, and again as in 1973, more than half of that figure was accounted for by material originating in the People's Republic of China.

Tariffs.—Schedules applicable throughout 1974 provided for import duties on the various classifications of talc as follows: Crude and not ground, 0.02 cent per pound; ground, washed, powdered, or pulverized, 6% ad valorem; cut or sawed, or in blanks, crayons, cubes, disks, or other forms, 0.2 cent per pound; and other, not specially provided for, 12% ad valorem.

Table 6.—U.S. exports of talc, soapstone, and pyrophyllite, crude and ground
(Thousand short tons and thousand dollars)

Year	Quantity	Value
1972	171	5,791
1973	180	6,618
1974	183	6,711

Table 7.—U.S. imports for consumption of talc, steatite or soapstone, by class and country

Year and country	Crude and unground		Ground, washed, powdered, or pulverized		Cut and sawed		Total unmanufactured	
	Quantity (short tons)	Value (thousands)	Quantity (short tons)	Value (thousands)	Quantity (short tons)	Value (thousands)	Quantity (short tons)	Value[1] (thousands)
1972	18,879	$871	9,471	$349	735	$449	29,085	$1,669
1973:								
Brazil	--	--	141	14	--	--	141	14
Canada	4,424	44	3,994	138	5	1	8,423	183
France	2,536	46	1,821	98	--	--	4,357	144
Hong Kong	--	--	--	--	190	112	190	112
India	--	--	--	--	9	5	9	5
Italy	7,507	600	1,080	129	--	--	8,587	729
Japan	--	--	--	--	433	344	433	344
Korea, Republic of	--	--	734	57	119	70	853	127
Total	14,467	690	7,770	436	756	532	22,993	1,658
1974:								
Australia	--	--	--	--	([2])	2	([2])	2
Austria	--	--	--	--	1	1	1	1
Brazil	--	--	23	2	--	--	23	2
Canada	5,598	58	4,717	213	1	1	10,311	272
China, People's Republic of	--	--	223	11	--	--	223	11
France	3,903	120	1,361	81	--	--	5,264	201
Hong Kong	--	--	--	--	323	205	323	205
India	--	--	--	--	2	1	2	1
Israel	--	--	20	5	--	--	20	5
Italy	12,087	910	914	152	7	15	13,008	1,077
Japan	9	7	--	--	355	281	364	288
Korea, Republic of	--	--	599	77	114	91	713	168
Total	21,592	1,095	7,857	541	803	597	30,252	2,233

[r] Revised.

[1] Does not include talc, n.s.p.f.: 1972, $128,925; 1973, [r] $231,300; 1974, $224,375.

[2] Less than ½ unit.

WORLD REVIEW

Talc-group minerals were produced in at least 45 different countries in 1974. Total world output of these materials was estimated at about 6.0 million short tons, 4% greater than the corresponding figure for 1973. Newcomers to the list of producers were Afghanistan, Ethiopia, and Sudan. It is believed that there may have been significant production also in a few other countries; however, confirming data are not available. About 60% of the world production was classified as talc (or steatite) and 40% as pyrophyllite. Japan was, as usual and by a wide margin, the world's foremost producer and consumer of pyrophyllite.[4]

Finland.—Finland's production of industrial minerals currently amounts to over half a million tons yearly, and approximately one-fourth of that total consists of high-grade talc produced by froth flotation from a mill feed in which talc and magnesite are present in roughly equal proportions. All but a small part of the product is consumed in the country in paper manufacturing, and the export trade is of minor importance.[5]

India.—An industrial association published an updated version of an earlier report that, while emphasizing the mining industry of India and presenting a register of names and addresses of that nation's producers, also outlined the international situation of 17 important industrial minerals—one of which was talc "steatite"—with regard to world occurrences, production, reserves, and export-import trade.[6]

United Kingdom.—The geological occurrence of talc in the United Kingdom and its exploitation, processing, and industrial applications were the principal subjects covered in a government agency publication, the tenth in a series of "Mineral Dossiers." Subdivisions of the report dealt with a number of other aspects of the talc industry in the United Kingdom including resources, uses, specifications, current price, costs, technology, and overseas trade.[7] Talc is produced in the United Kingdom at present only from mines near Baltasound on the island of Unst, the northernmost of the Shetlands group off the northeast coast of Scotland. Limited docking facilities are a major impediment to expansion of those operations, and at least three-quarters of the current talc requirement of the United Kingdom must be supplied by imports, mainly from Norway, France, Italy, and the People's Republic of China.

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[4] Industrial Minerals (London). Roskill on Talc and Pyrophyllite. No. 76, January 1974, p. 23.

[5] Saikkonen, R. Finland's Industrial Minerals and Their Growing Markets. Industrial Minerals (London). No. 81, June 1974, p. 38.

[6] Federation of Indian Mineral Industries. Export Possibilities of Minor Minerals. New Delhi, India, 1974.

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[7] Highley, D. E. Mineral Dossier No. 10: Talc. Miner. Res. Div., Inst. Geol. Sc., H.M. Sta. Off. (London), 1974, 25 pp.

Table 8.—Talc, soapstone, and pyrophyllite: World production by country
(Short tons)

Country [1]	1972	1973	1974 [p]
North America:			
Canada (shipments)	80,946	81,495	93,000
Mexico	3,450	2,324	2,920
United States	[r] 1,107,403	1,246,534	1,267,633
South America:			
Argentina	[r] 40,716	49,097	[e] 57,000
Brazil (talc)	[r] 97,811	[r] [e] 99,000	[e] 99,000
Chile	[r] 2,883	1,938	1,856
Colombia	[e] 2,477	992	[e] 1,000
Paraguay	243	276	276
Peru (talc and pyrophyllite)	10,958	[r] [e] 11,000	[e] 11,000
Uruguay	1,458	2,201	2,287
Europe:			
Austria	91,725	101,638	108,511
Finland	99,568	120,928	141,392
France (ground talc)	[r] 260,228	284,188	334,996
Germany, West (marketable)	34,743	32,754	[e] 33,000
Greece (steatite)	5,998	2,717	[e] 2,800
Hungary [e]	17,600	17,600	17,600
Italy (talc and steatite)	[r] 162,090	161,539	[e] 172,000
Norway	159,338	150,396	[e] 154,000
Portugal	1,327	1,224	1,091
Romania [e]	63,000	66,000	66,000
Spain	[r] 44,487	44,644	[e] 45,000
Sweden	[r] 29,106	30,897	[e] 33,000
U.S.S.R. [e]	430,000	440,000	450,000
United Kingdom	[r] 17,747	22,418	[e] 26,000
Africa:			
Afghanistan [2]	--	--	3,307
Angola	77	[e] 110	[e] 110
Egypt	8,518	7,756	[e] 7,700
Ethiopia	--	--	3
South Africa, Republic of [3]	11,926	13,055	19,840
Sudan	--	--	[e] 5,500
Swaziland (pyrophyllite)	119	139	40
Zambia	4,905	1,467	152
Asia:			
Burma	[e] 240	141	[e] 170
China, People's Republic of [e]	165,000	165,000	165,000
India	[r] 249,162	228,344	[e] 231,000
Japan [4]	[r] 1,651,162	1,723,540	1,734,878
Korea, North [e]	110,000	120,000	130,000
Korea, Republic of (talc and pyrophyllite)	259,867	460,693	[e] 496,000
Nepal [5]	--	49	278
Pakistan (talc and soapstone)	[r] 5,656	6,571	8,160
Philippines	1,110	1,801	[e] 2,500
Taiwan	27,328	25,490	14,900
Thailand (talc and pyrophyllite)	1,709	10,610	1,982
Oceania: Australia	[r] 61,893	71,439	[e] 80,000
Total	[r] 5,323,974	5,808,000	6,022,882

[e] Estimate. [p] Preliminary. [r] Revised.

[1] In addition to the countries listed, Southern Rhodesia is believed to produce talc, but available information is inadequate to make estimates of output levels.

[2] Calendar year Mar. 20, 1974, to Mar. 20, 1975.

[3] Includes talc and wonderstone (pyrophyllite).

[4] Includes talc and pyrophyllite; in addition, pyrophyllite clay is produced as follows in short tons: 1972—[r] 338,401; 1973—[r] 355,095; 1974—466,030.

[5] Data based on Nepalese fiscal year, mid-July 1973 to mid-July 1974.

TECHNOLOGY

A wide diversity of materials are employed as fillers, extenders, and binders in plastics formulations to give products with superior characteristics, and talc is among the substances being used in ever greater quantities for that purpose. The theoretical and mechanical aspects of the functions of fillers for plastics were discussed in an article published in a chemical journal.[8]

A brief outline of the talc industry from the Canadian viewpoint was presented in a magazine article. The dry mill and wet mill flow sheets of Canada's most important talc producer, Baker Talc Ltd., were illustrated.[9]

The physical, mechanical, and electrical properties, maximum recommended operating temperature, and uses of steatite ceramics (in which talc is a major and essential component) were summarized in a published tabulation.[10] Talc was one of the substances making up a coating compound suggested for protecting from acid corrosion the inner surfaces of concrete leaching vats used in increasing numbers in the rapidly evolving hydrometallurgy of copper.[11] It was stated that an abundantly available raw material, Montana talc, can be processed to make a synthetic form of hectorite purer than naturally occurring clay mineral, that has desirable rheological properties for mud, paint, and grease applications. British Patent 1,321,338 reportedly was granted for this application, but other pertinent information was not given.[12]

A patent was issued for a process in which platy talc is recovered and simultaneously separated from accompanying granular and/or acicular talc particles and objectionable foreign substances of gritty texture.[13] Ultraviolet induced fluorescence is applied in a patented procedure to make possible the recovery of high-purity platy talc substantially free from tremolite with which it is closely associated in some ores. After segregation of the white fluorescing fraction (talc) from the nonwhite fluorescing material (tremolite), the final separation is accomplished by froth flotation.[14]

The possible involvement of finely divided, airborne talc in some respiratory pathologies has become a frequent topic for debate in medical, technical, and popular publications. An article in a mining magazine provided a useful review of some of the conclusions reached by investigators of this subject, but a definition of terms could have added to the value of the study. The statement was made, for example, that ". . . results indicate that talc is predominantly cytogenetic . . ." The significance of cytogenetic in this context seems obscure.[15]

Because of the health hazards attributed to certain substances that occur as impurities in some commercial varieties of talc, development of adequate methods of testing for their presence has become an urgent necessity. It was stated that step-scanning X-ray diffraction and transmission electron microscopy are the most reliable of all the currently available techniques for identifying and quantitatively estimating asbestos and asbestiform minerals in talc ores down to fractional-percentage levels.[16]

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[8] Seymour, R. The Role of Fillers in Plastics Composites. Chemtech, July 1974, pp. 422–425.

[9] Western Miner. Talc: A Versatile Mineral. V. 47, No. 11, November 1974, pp. 26–27.

[10] Materials Engineering. Materials Selector: Mechanical and Electrical Ceramics—Fired Parts. V. 80, No. 4, Mid-September 1974, p. 287.

[11] Industry Week. Emerging Technologies. V. 182, No. 10, Sept. 2, 1974, p. 24.

[12] Mining Magazine (London). Industrial Minerals. V. 130, No. 4, April 1974, p. 324.

[13] Roe, L. A. (assigned to R. T. Vanderbilt, Inc.). Talc Beneficiating Process. U.S. Pat. 3,806,043, Apr. 23, 1974.

[14] Baak, T. (assigned to Cyprus Mines Corp.). Beneficiation of New York State Talc. U.S. Pat. 3,837,582, Sept. 24, 1974.

[15] Rajhans, G. S. Talc Dust and Its Toxicity. Can. Min. & Met. Bull., v. 67, No. 744, April 1974, pp. 117–118.

[16] American Paint & Coatings Journal. X-Ray Diffraction, Electron Microscopy Valuable Tools To Detect Asbestos in Talc, Philadelphians Hear. V. 58, No. 50, May 27, 1974, p. 46.

Thorium

By Roman V. Sondermayer [1]

Supplies from two domestic mines, both in Florida, and imports, mostly from Malaysia, were more than adequate to meet demand for thorium during 1974. Despite a 38% decline in domestic production, about 30% of the newly mined and imported thorium was stored as residues in holding areas. As in the past, there was no direct mine production of thorium. Monazite, the principal source of thorium, was a byproduct of titanium mining and was recovered for its rare-earth content.

Humphreys Mining Co. moved its mining operation from a location near Folkston, Ga., where the reserves were exhausted, to a location south of the State line in Florida.

A weak market continued throughout 1974, but long-range potential for the use of thorium was considered good. Energy shortages in the industrialized countries stimulated a search for new sources of energy. The existence of large resources of thorium in the United States and worldwide encouraged research on the use of thorium as a nuclear fuel and on thorium-fueled reactors. However, lower demand for electric power and increased capital costs for constructing thorium-fueled, high-temperature, gas-cooled reactors (HTGR) resulted in cancellations of orders for new reactors. This trend could adversely affect future demand for thorium.

During 1974, the most significant events concerning thorium were related to research and to industrial activities. Research continued on improvement of the HTGR and on its use as an industrial source for process heat and power generation. Work continued on the light water breeder reactor (LWBR) concept. A demonstration core containing thorium was scheduled for installation in an operating pressurized water reactor (PWR) in 1976.

Preliminary work started on a General Atomic Co. (GA) plant for production of thorium-uranium fuels and on an Atomic Energy Commission (AEC) [2] facility for reprocessing thorium fuels. At the beginning of the year, 10 HTGR's, with a total capacity of 8,000 megawatts electrical (Mwe), were on order. At yearend, one HTGR, a 40-Mwe plant at Peach Bottom, Pa., terminated production of electric power, and orders for two HTGR's had been canceled. The 330-Mwe HTGR at St. Vrain, Colo., was rescheduled for initial operation in 1975.

DOMESTIC PRODUCTION

Mine Production.—During 1974, two mines in Florida were the only domestic producers of thorium. As in the past, thorium was a byproduct of beach sand mining for titanium and recovery of rare-earth elements. U.S. mine production of thorium declined 38% compared with that of 1973. A move to a new mining area by one producer and difficulties in dredging encountered by another caused the decline.

Humphreys Mining Co. moved its dredging operation, including the wet plant, from a location near Folkston, Ga., to a nearby location in Florida; the dry plant remained in Georgia. When normal operations were resumed, wet concentrates from the new mining area were moved by 20-ton trucks to the dry plant at Folkston, Ga.

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[1] Physical scientist, Division of Nonferrous Metals.

[2] The Energy Reorganization Act of 1974, enacted on October 11, 1974, abolished the Atomic Energy Commission and established the Energy Research and Development Administration (ERDA) and the Nuclear Regulatory Commission (NRC).

Titanium Enterprises, jointly owned by American Cyanamid Co. and Union Camp Corp., was the second domestic monazite producer. At this operation, located near Green Cove Springs, Fla., the company mined a Pleistocene beach sand deposit mostly for ilmenite, rutile, and zircon. As in Georgia, monazite was a byproduct, and suction dredges were the principal mining equipment. During the year, production of monazite was lower than mine capacity. Installation of a new, heavier dredge caused a slowdown in production.

Ethyl Corp., Baton Rouge, La., explored beach sand deposits and operated a pilot plant for recovering monazite near Kentucky Lake, Paris Landing, Tenn. The project was opposed because of possible adverse environmental impact on a nearby recreation area.

Construction of a plant for fabricating thorium nuclear fuels was started at Youngsville, N.C. GA is planning startup in 1978 and full operation in 1979. The plant will use new technology, for which details were not announced. The multimillion-dollar project will have an initial capacity of six cores (24,000 fuel elements) per year and, toward the end of century, the plant will have an annual capacity of 20 cores.

Refinery Production.—The only significant domestic firm processing monazite for thorium was W. R. Grace & Co., Davison Chemical Division, at Chattanooga, Tenn. Lindsay Rare Earths, which was affiliated with Kerr-McGee Chemical Corp., West Chicago, Ill., stopped production in 1973, and was in the process of liquidating stock and preparing to dismantle the plant because of radioactive contamination. At yearend, no decision was made on disposal of the ponds, which contain sludges with an estimated million pounds of ThO_2.

Table 1.—Companies processing and fabricating thorium in 1974

Company	Plant location	Operations and products
American Light Alloys, Inc	Little Falls, N.J	Magnesium-thorium alloy.
Consolidated Aluminum Corp	Madison, Ill	Do.
Controlled Castings Corp	Plainview, N.Y	Do.
Gallard-Schlesinger Chemical Manufacturing Corp	Carle Place, N.Y	Processes oxide, fluoride, and metal.
General Atomic Co	San Diego, Calif	Nuclear fuels.
General Electric Co	San Jose, Calif	Do.
Do	Wilmington, N.C	Do.
W. R. Grace & Co	Chattanooga, Tenn	Processes domestic and imported monazite; produces oxide; stocks of hydroxide and metal powder.
Gulf United Nuclear Fuels Corp	Hematite, Mo	Nuclear fuels.
Do	New Haven, Conn	Do.
Hitchcock Industries, Inc	South Bloomington, Minn.	Magnesium-thorium alloys.
Kerr-McGee Chemical Corp	Cimarron, Okla	Nuclear fuels.
NL Industries, Inc	Albany, N.Y	Do.
Nuclear Chemicals and Metals Corp	Huntsville, Tenn	Do.
Nuclear Fuels Services, Inc	Erwin, Tenn	Do.
Nuclear Materials & Equipment Corp. (NUMEC)	Apollo, Pa	Do.
Do	Leechburg, Pa	Do.
Ventron Corp., Chemicals Div	Beverly, Mass	Metallic thorium.
Wellman Dynamics Corp	Creston, Iowa	Magnesium-thorium alloy.
Westinghouse Electric Corp	Bloomfield, N.J	Processes compounds; produces metallic thorium.
Do	Columbia, S.C	Nuclear fuels.

CONSUMPTION AND USES

Estimated apparent consumption of monazite and thorium compounds was about 200 tons of ThO_2 equivalent. This estimate was based on domestic mine production, imports, and changes in domestic stocks of monazite and thorium compounds. Actual industrial demand was substantially lower; the available monazite supply was processed essentially for its rare-earth content, and most of the thorium-containing residues entered company holding areas.

Based on sales from Government stocks and shipments from processors, U.S. industrial demand was estimated at about 80 tons of ThO_2 equivalent. Of the total, about 40 tons of ThO_2 was consumed in nonenergy sectors of the economy. Principal applications were in Welsbach incandescent gaslight mantles, as a hardener for magnesium-thorium alloys, in desperion hardening, refractories, electronics, and chemical (catalytic) applications. About 40 tons of ThO_2 equivalent was used for producing nuclear fuels and for nuclear research.

Philadelphia Electric Co. announced final shutdown of its 40-megawatt Peach Bottom nuclear electric plant, the company's first thorium-fueled, in October 1974. The plant had served an experimental role in the use of thorium-based nuclear fuels and was scheduled to be decommissioned in 1975.

Louisiana Power and Light Co. ordered two 1,160-Mwe HTGR's from GA in early 1974. The new powerplant, called the St. Rosalie Station, will be sited on the west bank of the Mississippi River between the towns of Alliance and Myrtle Grove in Plaquemines Parish. The schedule calls for operation of the first unit in December 1982. The second unit should be operational at the end of 1984.

Southern California Edison Co. (SCE) canceled its contract with GA for two 770-Mwe HTGR's. Consumer conservation measures resulting in decreased demand for power, as well as difficulties in capital financing, were reported as the main factors in the decision to cancel. While canceling the contract, SCE signed a letter of intent for a feasibility study on the construction of two 1,500-Mwe HTGR's at the same locality.

Table 2.—Status of HTGR development in the United States [1]

State	Station (plants)	Capacity (megawatts electric)	Status	Scheduled start of commercial operation
California	Eastern: Desert 1	770	Canceled	1981
Do	Eastern: Desert 2	770	do	1983
Colorado	Fort St. Vrain	330	Plant in power ascension phase.	1975
Delaware	Summit 1	770	Construction permit application in preparation.	1979
Do	Summit 2	770		1982
Louisiana	St. Rosalie 1	1,160		1982
Do	St. Rosalie 2	1,160		1984
Pennsylvania	Peach Bottom 1	40	Final shutdown	1967
Do	Fulton 1	1,160	Construction permit application in preparation.	1981
Do	Fulton 2	1,160		1983
Total	10	8,090		

[1] At yearend 1974.

STOCKS

The Government stockpile, in the form of thorium nitrate, totaled 7,285,200 pounds on January 1, 1975. The thorium stockpile objective was zero during the year. Except for 174,300 pounds of nitrate, all stockpiled thorium-containing materials were available for disposal. About 301,102 pounds of nitrate was sold from the stockpile during the year.

Stocks held by industry were estimated in terms of ThO_2 equivalent, as follows: In monazite, 73 tons; in compounds, 77 tons; and in metal and alloys, 1 ton.

PRICES

The price of monazite concentrate increased on the international market. The average declared value for the imported concentrate was $170 per ton compared with $135 in 1973.

Prices listed by the Davison Chemical Division, W. R. Grace & Co., Chattanooga, Tenn., were in the following ranges, per pound, depending on the quantity of purchase: Nitrate, wire grade, 47% ThO_2,

\$2.95–\$3; nitrate, mantle grade, 47% ThO_2, \$3–\$3.10; ThO_2, ceramic grade, 99.9% ThO_2, \$6–\$12; and ThO_2 nuclear grade, 99.9% ThO_2, \$8–\$12.

Quotations in the American Metal Market on thorium metal in pellets remained steady at \$15 per pound. The pure metal was \$65 per pound.

FOREIGN TRADE

During 1974, the United States exported thorium ores. This was the first significant export of these ores in the past decade.

Imports of monazite decreased below 1973 levels. Malaysia was the principal supplier. Imports of thorium compounds increased, but imports of thorium metal (scrap) decreased. The European countries and Canada were the main suppliers.

Table 3.—U.S. foreign trade in thorium and thorium-bearing materials

(Quantity in pounds unless otherwise specified)

	1972		1973		1974		Principal sources and destinations, 1974
	Quantity	Value	Quantity	Value	Quantity	Value	
EXPORTS							
Ore and concentrate (ThO_2 content)	--	--	2,188	$18,724	156,430	$270,252	All to France.
Metals and alloys[1]	16,624	$291,048	14,787	269,708	20,496	321,982	Italy 9,606; Canada 8,791; Japan 1,348; Brazil 350; Switzerland 308; Other 93.
Compounds[1]	6,714,148	46,614,501	4,028,095	26,107,130	4,682,926	30,855,227	Canada 3,231,748; United Kingdom 576,392; France 498,673; Italy 348,819; Japan 20,788; Ireland 5,511; Other 995.
IMPORTS							
Ore and concentrate:							
Monazite (short tons)	894	88,767	1,876	254,125	1,179	200,527	Malaysia 879; Thailand 300.
ThO_2 content[e]	107,300	--	300,160	--			
Waste and scrap	15	285	20	280	15	308	All from Canada.
Compounds:							
Nitrate	4,502	15,612	2,200	3,104	8,083	13,939	All from France.
Oxide	317	1,833	1,603	5,811	12,000	48,781	Do.
Oxide equivalent, in gas mantles[e 2]	5,804	539,558	3,882	453,692	3,349	399,545	Austria 926; Malta 876; United Kingdom 727.
Other	151	22,811	177	32,754	172	23,394	Switzerland 89; West Germany 83.

[e] Estimate.

[1] Includes uranium; thorium and uranium are undifferentiated in official statistics.

[2] Based on manufacture of 1,000 gas mantles per pound ThO_2.

WORLD REVIEW

The world thorium industry was small compared with other energy-producing mineral industries. During 1974, Australia, India, Malaysia, Brazil, and the United States remained the principle thorium producers. Thorium processing was widely dispersed among a number of countries. Table 4 lists the principal monazite-producing countries among the market economies.

Table 4.—Monazite concentrate: World production, by country
(Short tons)

Country [1]	1972	1973	1974 [p]
Australia	[r] 5,630	4,725	[e] 4,000
Brazil	[r] 2,303	1,606	[e] 1,650
India	4,504	3,858	[e] 3,300
Malaysia [2]	1,927	[e] 2,200	[e] 2,200
Mauritania [e]	110	110	110
Nigeria	11	6	[e] 6
Sri Lanka [e]	10	10	10
Thailand	188	351	[e] 390
United States	W	W	W
Zaire	251	250	[e] 250
Total	[r] 14,934	13,116	[e] 11,916

[e] Estimate. [p] Preliminary. [r] Revised.

W Withheld to avoid disclosing individual company confidential data.

[1] In addition to the countries listed, Indonesia and North Korea produce monazite, but available information is inadequate to make reliable estimates of output levels.

[2] Exports.

Australia.—Development began on a new mineral project owned by Allied Eneabba Pty. Ltd., near Eneabba, Western Australia. Among other products, monazite will be recovered at a site near Geraldton. Total cost of the project was reported at $17.2 million.

Westralian Sands Ltd. started a new development program to increase production. Reopening of the concentrator at Yoganup and commissioning of a new dry plant are the principal features of the program.

Brazil.—The Commissão Nacional de Energia Nuclear (CNEN), a Brazilian Government agency, controlled the beach sand industry of Brazil. This industry remained the only producer of monazite in the country.

CNEN, through its Administração da Produção da Monazita (APM), operated workings at Itabapoana (Rio de Janiero) and Cumuruxatiba (Bahia). Monazita e Ilmenita do Brasil (MIBRA), a privately owned company, operated facilities for the production of monazite at Guarapari.

In addition, Grupo do Thorio da Divisoro de Reatores do Instituto de Pesgguisas Radioactivas, in Belo Horizonte, studied and planned different uses of thorium.

Mineral Deposit Ltd. of Australia and the Government of Brazil were planning a joint venture to explore beach sands in Brazil. If new beach sand deposits are discovered, a joint company will be established to mine and market ilmenite, monazite, and associated minerals.

France.—La Rochelle facility, owned by Rhône Progil, was the largest processor of monazite in Europe during 1974. About 5,000 to 6,000 tons of monazite was processed, and 150 to 200 tons of ThO_2 equivalent was recovered. Australia supplied about 75% of French monazite requirements. The United States exported about 78 tons of ThO_2 equivalent, in the form of monazite, to France. This represents the first large U.S. export of thorium-bearing material to France in the past decade.

Germany, West.—Hochtemperatur-Reaktorbau GmbH (HRB), Cologne, which was building a 300-Mwe thorium-fueled demonstration plant at Schmehausen, proposed a marketing program for nuclear process heat. The Arbeitsgemeinshaft Nuklear Processwarme (ANP), a joint venture for the use of nuclear process heat, was established by eight German companies. ANP planned a 750-Mwe reactor to start production in 1982.

India.—Government-owned Indian Rare Earths Ltd. continued as the only mineral sand mining and processing firm in India. The company's mineral division, with offices at Quilon, State of Kerala, operated raw material plants at Manavalakurichi and at Chavara. The average ThO_2 content of India monazite ranged from 8% to 10%. Production of thorium hydroxide (dry) was reported at about 700 tons. Installed capacity for production of thorium hydroxide was 904 tons per year.

WORLD RESOURCES

Resources of thorium in market economy countries were evaluated by the U.S. Geological Survey,[3] as shown in table 5.

Table 5.—Resources of thorium in market economy countries [1]
(Thousand short tons)

State	Recoverable as byproduct or coproduct	Recoverable for grade of 0.1% ThO_2 or higher	Recoverable for grade less than 0.1% ThO_2
Australia	50	--	--
Brazil	150	14.0	--
Canada	580	--	--
Greenland	--	--	750
Republic of South Africa	75	--	--
United States	46	106.5	142
Others	84	--	10

[1] Not shown, because of inadequate data, are resources of Argentina, Sri Lanka, Norway, Uruguay, and several other countries.

TECHNOLOGY

Energy, process heat, metallurgical applications, and isotopes were the principal subjects of research related to thorium. Approximately two-thirds of the thorium research was on energy applications.

In electrochemical studies of thorium in molten LiF–NaF–KF at 500° C a reduction wave was obtained at the nickel and tungsten electrodes. Analysis indicated that Th(IV) was reversibly reduced to the metal with alloy formation between deposited thorium and the nickel.[4]

Separation of trace amounts of thorium and its determination was the subject of another study. Thorium can be separated by reversed phase chromatography from a variety of matrices, especially complex natural silicates.[5]

Energy research was directed toward development of thorium fuels, their fabrication and reprocessing, and standardization and development of reactor concepts. In addition, use of the HTGR as a source of process heat continued to be examined during 1974. Among others, coal gasification, steelmaking, water splitting (hydrogen production), and petroleum production from oil shales and tar sands were examined to determine uses of high-temperature-process heat.

The AEC was planning to accelerate its program to develop technology for the recycling of fuels used in HTGR's. This was part of the AEC thorium utilization program. The proposed accelerated effort included demonstration of fuel reprocessing and refabrication technology for HTGR's.[6]

GA, the only producer of a commercial HTGR, was selected by the American Electric Power System to carry out a joint program to develop the technology for a standardized HTGR.[7] The direct-cycle gas turbine was among research projects at the GA facilities in La Jolla, Calif. This would lead to construction of a commercial plant, possibly in 1979, and commercial service in 1985.

The LWBR program, using the PWR to convert thorium to fissionable uranium-233, was near the final stage. Plans called for the installation of a demonstration core in 1976 to test the concept. Once on the breeding cycle, a LWBR replacement core could be produced without further mining or enrichment of uranium ores. Successful operation of the demonstration core might permit conversion of operating or presently planned PWR's to LWBR cores without extensive and costly changes to existing installations.

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[3] Staatz, M. H., and J. C. Olson. Thorium. Ch. in United States Mineral Resources. U.S. Geol. Survey Prof. Paper 820, 1973, pp. 468–476.

[4] Clayton, F. R., and G. Mamantov. Electrochemical Studies of Uranium and Thorium in Molten LiF–NaF–KF at 500° C. J. Electrochem. Soc., v. 121, No. 1, January 1974, pp. 86–90.

[5] Arden, J. W., and N. H. Gale. Separation of Trace Amounts of Uranium and Thorium and Their Determination by Mass Spectrometric Isotope Dilution. Anal. Chem., v. 46, No. 6, May 1974, pp. 687–691.

[6] American Nuclear Society. HTGR Fuel Fabrication Reprocessing Units Being Developed. Nuclear Ind., v. 21, No. 6, June 1974, pp. 26–29.

[7] American Nuclear Society. Standardized HTGR Design for "Series" of 1,500 Megawatts Plants. Nuclear Ind., v. 21, No. 1, January 1974, p. 25.

The conversion of thorium-232 to uranium-233, using neutrons released by nuclear fusion, was also under investigation.[5]

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[5] Brand, D. Fusion Devices Hold Promise for Producing Nuclear Fuel From Two Common Elements. Wall Street J., v. 184, No. 29, Aug. 9, 1974, p. 28.

Tin

By Keith L. Harris [1]

The world supply of tin trended from undersupply during the first half of the year to a balance between supply and demand by yearend as combined releases of over 24,000 long tons [2] of tin from the U.S. Government stockpile and the International Tin Council (ITC) buffer stock and a world economic downturn helped offset the deficiency between world mine production and world consumption. World mine production dropped 2% from the 1973 level to 228,000 tons. Prices, forced upward by currency problems, tight metal supply, inflation, and speculation during the first half of the year, settled into the lower sector of the ITC price range at the end of the year.

U.S. consumption of primary and secondary tin decreased 13% to 64,700 tons. The major uses for tin were in tinplate, 34%; solder, 24%; bronze and brass, 14%; chemicals including tin oxide, 8%; and babbitt, 5%. Most of the nation's tin, in the form of slabs, bars, and ingots, came from Malaysia and Thailand. Less than 200 tons of tin from mines in Alaska, Colorado, and New Mexico was mined domestically. About one-fifth of the tin used in the United States in 1974 was reclaimed from scrap at about 85 secondary smelters.

The only primary tin smelter-refinery operating in the United States in 1974 was the Texas City, Tex., facility of Gulf Chemical & Metallurgical Co. (GCMC). The major feed to the smelter was tin concentrate from Bolivia's State-owned Corporación Minera de Bolivia (COMIBOL).

The average New York price for prompt delivery Straits (Malaysian) tin in 1974 was 396.266 cents per pound, a significant increase from the 1973 average of 227.558 cents per pound.

In May, the ITC reacted to increased production costs by raising the floor and ceiling prices for tin by 34% and 38%, respectively. The General Services Administration (GSA) sold 23,457 tons of tin from the stockpile through commercial channels.

Table 1.—Salient tin statistics
(Long tons)

	1970	1971	1972	1973	1974
United States:					
Production:					
Mine	W	W	W	W	W
Smelter	NA	4,000	4,300	r 4,800	6,000
Secondary	20,001	20,096	20,180	20,477	18,897
Exports (including reexports)	4,452	2,262	1,184	3,406	8,415
Imports for consumption:					
Metal	50,554	46,940	52,451	45,845	39,602
Ore (tin content)	4,667	3,060	4,216	r 4,798	5,877
Consumption:					
Primary	52,957	51,980	58,501	58,142	51,611
Secondary	20,880	17,970	15,700	16,498	13,131
Price: Straits tin, in New York, average cents per pound	174.185	167.344	177.469	227.558	396.266
World production:					
Mine	228,500	232,232	r 240,331	r 232,358	227,642
Smelter	223,696	231,901	r 236,331	r 228,336	225,501

r Revised. NA Not available. W Withheld to avoid disclosing individual company confidential data.

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[1] Physical scientist, Division of Nonferrous Metals.

[2] Unless otherwise specified all units are long tons of contained tin.

Legislation and Government Programs.—GSA continued commercial sales of surplus tin during the year. On April 29, sales of grade A tin from the stockpile were limited to U.S. consumers only, although export of grades B, C, and D tin continued. GSA also limited the amount of tin any one customer could purchase per day to no more than 10% of the remaining tin of each grade. Sales for the year totaled 23,469 tons, of which 23,457 tons were commercial. Shipments for the year totaled 23,554 tons. At yearend there was an excess of 166,948 tons above the 40,500-ton objective, of which 6,822 tons was authorized for sale by Congress. Over 140,000 tons of tin has been released from the Government stockpile since sales commenced in 1962. A bill seeking authorization to sell an additional 100,000 tons of stockpiled tin was submitted to Congress but received no action during the year.

The Office of Minerals Exploration (OME), U.S. Geological Survey continued its program of offering participatory loans for tin exploration up to 75% of approved costs.

The depletion allowance for tin remained at 22% for domestic deposits and 14% for foreign deposits.

DOMESTIC PRODUCTION

PRIMARY TIN

Mine Production.—Domestic production of tin in 1974 was less than 200 tons. Most of the year's output came from Colorado as a byproduct of molybdenum mining. Some tin concentrate was produced at dredging operations in Alaska and placer operations in New Mexico.

The Lost River Mining Corp., Ltd., a subsidiary of P.C.E. Explorations Ltd., was evaluating a tin-tungsten-fluorspar property on Alaska's Seward Peninsula, and entered into a long-term agreement with the Bering Straits Native Corp. Bering received an option to acquire equity interest in any subsequent mining operation while assisting Lost River in financing the $80 million operation. A feasibility study has been completed on mining and milling facilities for a 4,000-ton-per-day open pit operation. Lost River plans to develop an airstrip and deep-water port facilities near the property.

Smelter Production.—The only smelter in the United States is the Texas City, Tex., facility of GCMC. In 1974, GCMC received 5,877 tons of tin in concentrate from Bolivia which formed the base load, together with domestic tin concentrate and secondary tin-bearing materials. GCMC was operating under a 10-year contract negotiated with Bolivia in which Bolivia guaranteed to deliver 6,000 tons of concentrate to GCMC in each of the first 3 years of the contract.

SECONDARY TIN

The United States is the world's leader in the production of recycled, or secondary, tin. The United Kingdom, West Germany, Austria, and Australia also produce secondary tin in significant quantities.

Of the tin recycled during 1974, 89% was an alloy constituent of reclaimed bronzes, brasses, solders, and bearing and type metals. A small amount also remained in chemical compounds. Only 11% of the recycled tin, mostly from new tinplate scrap, found its way to market as metal. This latter volume provided only 2% of the total tin supplied to U.S. consumers in 1974, a proportion which does not vary appreciably from year to year.

Secondary tin furnishes about 25% of the total U.S. tin supply each year. In 1974 secondary tin produced in the United States decreased 8% from the 1973 level to 18,897 tons.

Five companies in 11 States were engaged in the detinning business in 1974. Normally the raw materials used are tinplate scrap and spent chemicals or tinning solutions.

Table 2.—Secondary tin recovered from scrap processed at detinning plants in the United States

	1973	1974
Tinplate scrap treated ---------- long tons --	764,158	706,428
Tin metal recovered in the form of—		
Metal ---------- do ----	1,416	1,426
Compounds (tin content) ---------- do ----	677	576
Total [1] ---------- do ----	2,093	2,002
Weight of tin compounds produced ---------- do ----	1,450	1,068
Average quantity of tin recovered per long ton of tinplate scrap used pounds --	6.13	6.35
Average delivered cost of tinplate scrap ---------- per long ton --	$48.90	$119.77

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[1] Recovery from tinplate scrap treated only. In addition, detinners recovered 364 long tons (371 tons in 1973) of tin as metal and in compounds from tin-base scrap and residues in 1974.

Table 3.—Tin recovered from scrap processed in the United States, by form of recovery

(Long tons)

Form of recovery	1973	1974
Tin metal:		
At detinning plants ----------	1,737	1,776
At other plants ----------	275	213
Total ----------	2,012	1,989
Bronze and brass:		
From copper-base scrap ----------	9,428	8,797
From lead and tin-base scrap ----------	59	25
Total ----------	9,487	8,822
Solder ----------	5,488	5,235
Type metal ----------	1,052	971
Babbitt ----------	751	561
Antimonial lead ----------	948	717
Chemical compounds ----------	727	590
Miscellaneous [1] ----------	12	12
Total ----------	8,978	8,086
Grand total ----------	20,477	18,897
Value (thousands) ----------	$104,377	$167,774

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[1] Includes foil, cable lead, and terne metal.

Table 4.—Shipments of metal cans[1]
(Thousand base boxes[2])

Type of can	1973	1974 [p]	1974 change (percent)
FOOD AND BEVERAGE			
Fruit and fruit juices	14,526	14,547	+0.1
Vegetables and vegetable juices	23,914	25,581	+6.9
Milk, evaporated and condensed	2,245	[3] 3,603	+41.7
Other dairy products	298		
Soft drinks	36,009	35,700	−.9
Beer	48,429	52,500	+8.4
Meat and poultry	3,681	3,555	−3.4
Fish and other seafoods	3,018	3,225	+6.9
Coffee	3,640	3,365	−7.6
Lard and shortening	1,745	2,028	+16.2
Baby foods	1,345	1,494	+11.1
Pet foods	7,121	7,042	−1.1
All other foods, including soups	14,280	15,814	+10.7
Total	160,251	168,454	+5.1
NONFOOD			
Oils	2,726	2,457	−9.9
Paint and varnish	5,432	5,081	−6.5
Antifreeze	303	([4])	([4])
Pressure packing (valve type)	6,103	5,765	−5.5
All other nonfood	5,273	5,260	−.3
Total	19,837	18,563	−6.4
Grand total	180,088	187,017	+3.9
BY METAL			
Steel-base boxes	146,506	147,593	+.7
Short tons (thousand)	5,792	5,821	+.5
Aluminum-base boxes	33,582	39,423	+17.2

[p] Preliminary.

[1] Includes tinplate and aluminum cans.

[2] The base box, a unit commonly used in the tinplate industry, equals 31,360 square inches of plate or 62,700 square inches of total surface area.

[3] Data for evaporated and condensed milk are now included under "dairy-based products."

[4] Included with "all other nonfoods."

Source: U.S. Department of Commerce.

Table 5.—Stocks, receipts, and consumption of new and old scrap and tin recovered in the United States in 1974

(Long tons)

Type of scrap and class of consumer	Gross weight of scrap						Tin recovered		
	Stocks Jan. 1	Receipts	Consumption			Stocks Dec. 31	New	Old	Total
			New	Old	Total				
Copper-base scrap:									
Secondary smelters:									
Auto radiators (unsweated)	3,245	58,890	--	58,952	58,952	3,183	--	2,320	2,320
Brass, composition or red	3,489	67,132	15,306	51,584	66,890	3,731	580	1,910	2,490
Brass, low (silicon bronze)	288	2,557	1,577	784	2,361	484	--	3	3
Brass, yellow	4,770	46,289	5,173	41,249	46,422	4,637	16	429	445
Bronze	1,852	22,781	3,990	19,324	23,314	1,269	315	1,508	1,823
Low-grade scrap and residues	11,631	53,689	43,871	8,921	52,792	12,528	16	--	16
Nickel silver	555	3,939	--	1,220	1,220	741	4	24	28
Railroad-car boxes	361	1,063	385	3,368	3,752	204	--	58	58
Total	26,191	251,290	70,302	180,402	250,704	26,777	931	6,252	7,183
Brass mills:[1]									
Brass, low (silicon bronze)	3,959	24,883	24,883	--	24,883	4,416	--	--	--
Brass, yellow	18,713	267,019	267,019	--	267,019	19,929	219	--	219
Bronze	776	4,749	4,749	--	4,749	1,136	213	--	213
Nickel silver	3,319	32,080	32,080	--	32,080	6,348	--	--	--
Total	26,767	328,731	328,731	--	328,731	31,829	432	--	432
Foundries and other plants:[2]									
Auto radiators (unsweated)	1,413	7,448	--	7,847	7,847	1,014	--	353	353
Brass, composition or red	704	6,223	2,055	4,087	6,142	785	96	192	288
Brass, low (silicon bronze)	47	761	328	430	758	50	--	7	7
Brass, yellow	593	6,534	4,259	2,203	6,462	665	--	18	18
Bronze	120	595	152	493	645	70	10	39	49
Low-grade scrap and residues	371	536	126	448	574	333	--	--	--
Nickel silver	1	5	--	6	6	--	--	--	--
Railroad-car boxes	150	6,117	--	6,019	6,019	248	--	286	286
Total	3,399	28,219	6,920	21,533	28,453	3,165	106	895	1,001
Total tin from copper-base scrap	X	XX	XX	XX	XX	XX	1,469	7,147	8,616
Lead-base scrap: Smelters, refiners, and others:									
Babbitt	601	10,493	--	10,737	10,737	357	--	521	521
Battery lead plates	48,415	552,698	--	548,539	548,539	52,569	--	580	580
Drosses and residues	19,642	126,393	115,536	--	115,536	30,499	2,428	--	2,428
Solder and tinny lead	1,068	11,606	--	12,199	12,199	470	--	1,898	1,898
Type metal	1,971	23,629	--	22,987	22,987	2,613	--	1,092	1,092
Total	71,692	724,814	115,536	594,462	709,998	86,508	2,428	4,086	6,509
Tin-base: Smelters, refiners, and others:									
Babbitt	28	186	--	196	196	18	--	163	163
Block-tin pipe	31	136	--	139	139	28	--	138	138
Drosses and residues	229	2,396	2,326	--	2,326	299	1,097	--	1,097
Pewter	2	9	--	9	9	2	--	8	8
Total	290	2,727	2,326	344	2,670	347	1,097	309	1,406
Tinplate and other scrap: Detinning plants	--	--	706,428		706,428	--	2,366	--	2,366
Grand total	XX	XX	XX	XX	XX	XX	7,355	11,542	18,897

XX Not applicable.

[1] Brass-mill stocks include home scrap, and purchased-scrap consumption is assumed equal to receipts; therefore, lines and total in brass-mill section do not balance.

[2] Omits "machine-shop scrap."

CONSUMPTION

U.S. consumption of primary and secondary tin declined 11% and 20%, respectively, with the total consumption of tin down 13%. The marked decrease in tin consumed for solder, down 9,388 tons, accounted for the majority of the decline. Consumption of tin for tinplate increased 5%, regaining its place as the most important use of tin, after being second to solder in 1973. However, the average amount of tin per short ton of tinplate continued to decrease with an average of 9.6 pounds of tin used per short ton of tinplate compared with 9.7 pounds in 1973. Consumption of tin increased slightly in bar tin, chemicals including tin oxide, and terne metal but decreased in all other sectors. U.S. brass mills consumed 1,013 tons of primary tin and 276 tons of secondary tin compared with the 1973 levels of 1,045 tons and 501 tons, respectively.

Table 6.—Consumption of primary and secondary tin in the United States
(Long tons)

	1970	1971	1972	1973 r	1974
Stocks Jan. 1 [1]	23,441	21,165	18,557	18,490	18,241
Net receipts during year:					
Primary	52,096	51,727	55,074	59,175	54,507
Secondary	2,502	2,491	2,797	4,025	2,249
Scrap	19,748	16,179	13,892	13,695	12,102
Total receipts	74,346	70,397	71,763	76,895	68,858
Total available	97,787	91,562	90,320	95,385	87,099
Tin consumed in manufactured products:					
Primary	52,957	51,980	53,501	58,142	51,611
Secondary	20,880	17,970	15,700	16,498	13,131
Total	73,837	69,950	69,201	74,640	64,742
Intercompany transactions in scrap	2,785	3,055	2,629	2,504	2,449
Total processed	76,622	73,005	71,830	77,144	67,191
Stocks Dec. 31 (total available less total processed)	21,165	18,557	18,490	18,241	19,908

r Revised.

[1] Stocks shown exclude tin in transit or in other warehouses on Jan. 1, as follows: 1970—80 tons; 1971—10 tons; 1972—140 tons; 1973—970 tons; and 1974—810 tons.

Table 7.—Tin content of tinplate produced in the United States

Year	Tinplate waste—waste, strips, cobbles, etc., gross weight (short tons)	Tinplate (all forms)		
		Gross weight (short tons)	Tin content [1] (long tons)	Tin per short ton of plate (pounds)
1970	625,998	5,590,038	25,127	10.1
1971	547,959	5,297,970	23,669	10.0
1972	501,996	4,706,491	21,070	10.0
1973	522,043	4,908,347	21,267	9.7
1974	440,866	5,182,890	22,328	9.6

[1] Includes small tonnage of secondary tin and tin acquired in chemicals.

Table 8.—Consumption of tin in the United States, by finished product

(Long tons of contained tin)

	1973			1974		
	Primary	Secondary	Total	Primary	Secondary	Total
Alloys (miscellaneous)	799	279	1,078	508	294	802
Babbitt	2,524	951	3,475	2,268	986	3,254
Bar tin	705	W	705	799	W	799
Bronze and brass	3,506	6,470	9,976	3,560	5,798	9,358
Chemicals including tin oxide	2,852	1,976	4,828	3,418	1,446	4,864
Collapsible tubes and foil	1,001	1	1,002	929	24	953
Solder	18,775	5,952	24,727	11,376	3,963	15,339
Terne metal	315	55	370	359	135	494
Tinning	2,541	44	2,585	2,478	45	2,523
Tinplate[1]	21,267	--	21,267	22,328	--	22,328
Tin powder	1,459	W	1,459	1,310	W	1,310
Type metal	80	560	640	118	221	339
White metal[2]	2,000	103	2,103	1,781	192	1,973
Other	318	107	425	379	27	406
Total	58,142	16,498	74,640	51,611	13,131	64,742

W Withheld to avoid disclosing individual company confidential data; included with "Other."

[1] Includes secondary pig tin and tin acquired in chemicals.

[2] Includes pewter, britannia metal, and jewelers' metal.

STOCKS

Yearend stocks of plant-held pig tin were 15% above the corresponding period of 1973. Tinplate mills, the largest consumers of pig tin, held 73% of the plant-held pig tin stocks at yearend. During the year, stocks rose to the year high of 9,090 tons in May, then fluctuated, ending the year at 8,952 tons. Tin in transit and jobber-importer held stocks were down from those in 1973 while tin in process and tin afloat to the United States recorded increases.

Table 9.—U.S. industry yearend tin stocks

(Long tons)

	1970	1971	1972	1973	1974
Plant raw materials:					
Pig tin:					
Virgin	9,451	7,779	8,152	r 7,537	8,645
Secondary	222	255	254	r 337	307
In process[1]	11,492	10,523	10,084	r 10,367	10,956
Total	21,165	18,557	18,490	r 18,241	19,908
Additional pig tin:					
In transit in United States	10	140	445	970	810
Jobbers-importers	1,635	1,630	2,720	1,135	680
Afloat to United States	3,500	4,510	3,725	3,630	4,340
Total	5,145	6,280	6,890	5,735	5,830
Grand total	26,310	24,837	25,380	r 23,976	25,738

r Revised.

[1] Tin content, including scrap.

PRICES

Prices of tin metal on the world markets were influenced by tight supply, inflation caused by higher oil prices, currency problems, and speculation during the first half of the year. In the latter half, prices declined following decreased world demand.

Average prices for the year reached record highs for all markets. The average price for cash tin on the London Metal Exchange (LME) was £3493.61 per metric ton (372.16 cents per pound) compared with £1960.44 per metric ton (218.04 cents per pound) in 1973. The average

Penang price for ex-works Straits tin was M$1,136.63 per picul[8] (354.12 cents per pound) compared with M$686.28 per picul (213.55 cents per pound) in 1973.

The Penang price for ex-works Straits tin began the year at M$820 per picul (255 cents per pound) and rose erratically to the year high of M$1,380 per picul (430 cents per pound) in late April. Profit taking actions caused the price to drop during May but with the upward revision of the ITC buffer stock range, the price climbed up again in June. After June, the Penang price, in general, declined, with the price passing through the ITC established ceiling price of M$1,050 per picul (327 cents per pound) on October 7. The Penang price had remained above the ITC ceiling prices since November 9, 1973. At yearend the Penang price was M$920 per picul (287 cents per pound), just inside the lower sector of the buffer stock range.

The LME introduced a new high-grade tin contract August 1. Prior to the introduction, tin traded on the LME was standard tin of 99.75% purity. With the closure of the Williams, Harvey & Co., Ltd. smelter, the source of standard tin for the LME, supplies of standard tin became scarce, causing the LME to initiate the 99.85% high-grade tin contract.

Table 10.—Monthly prices of Straits tin for prompt delivery in New York

(Cents per pound)

Month	1973			1974		
	High	Low	Average	High	Low	Average
January	180.000	177.750	179.045	313.500	280.000	298.136
February	202.500	181.250	192.014	383.000	325.750	351.492
March	210.000	201.000	205.102	406.750	366.500	389.405
April	204.000	199.000	202.400	467.000	408.500	440.762
May	214.000	202.000	209.114	470.000	427.000	456.875
June	218.750	207.500	212.274	473.250	448.000	462.813
July	247.750	218.000	237.548	449.250	412.500	426.568
August	248.500	239.000	243.565	432.000	414.250	422.977
September	241.750	238.750	240.303	434.000	404.500	415.913
October	252.000	239.000	245.909	399.500	347.750	367.420
November	284.750	252.000	262.440	384.000	365.000	370.961
December	345.000	274.250	300.461	366.000	340.750	351.869
Average	345.000	177.750	227.558	473.250	280.000	396.266

Source: Metals Week.

FOREIGN TRADE

Tin supplied by GSA sales of surplus stockpiled material lowered U.S. dependence on imports, as reflected by a 14% decline in tin metal imports in 1974. Of the 39,602 tons of tin metal imported, Malaysia furnished 52%; Thailand, 15%; Indonesia, 10%; and the People's Republic of China, 8%. Imports of tin-in-concentrate destined for the Texas City, Tex., smelter totaled 5,877 tons, up 31% from the 1973 level. Bolivia supplied all the concentrate.

Exports of metal from the United States more than doubled to 8,415 tons, the majority of which (5,585 tons) was exported prior to the late April GSA export restriction on grade A tin sold from the stockpile.

Small tonnages of secondary tin enter the United States as alloy constituents in recyclable solders or other alloys, or as tinplate or other scrap, dross, skimmings, and residues. These imports are reflected in consumption figures and account for the differences normally encountered between U.S. production and consumption of secondary tin. Imports and exports of tin in alloy such as babbitt, solder, type metal, and bronze are shown in the Minerals Yearbook chapters on "Copper" and "Lead." Ferrous scrap exports, including those of tinplate and terneplate scrap, are not classified separately.

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[8] One Malaysian dollar (M$)=US$0.4154; one picul=133.33 pounds.

Table 11.—U.S. exports and imports for consumption of tin, tinplate, and terneplate in various forms

Year	Ingots, pigs, and bars				Tinplate and terneplate				Tinplate circles, strips and cobbles		Tinplate scrap	
	Exports		Reexports		Exports		Imports		Exports		Imports	
	Quantity (long tons)	Value (thousands)	Quantity (long tons)	Value (thousands)	Quantity (long tons)	Value (thousands)	Quantity (long tons)	Value (thousands)	Quantity (long tons)	Value (thousands)	Quantity (long tons)	Value (thousands)
1972	857	$2,915	277	$1,055	245,355	$51,929	466,455	$107,844	4,076	$552	15,214	$437
1973	2,540	12,099	866	8,236	354,393	89,704	[r] 421,268	[r] 105,961	21,563	2,678	[r] 10,663	384
1974	5,908	47,774	2,507	15,700	427,938	166,843	284,818	98,349	15,532	2,654	11,290	861

[r] Revised

Table 12.—U.S. imports for consumption and exports of miscellaneous tin, tin manufactures, and tin compounds

Year	Miscellaneous tin and manufactures				Tin compounds	
	Imports			Exports	Imports	
	Tinfoil, tin powder, flitters, metallics, tin and manufactures, n.s.p.f.	Dross, skimmings, scrap, residues, and tin alloys, n.s.p.f.		Tin scrap and other tin-bearing material, except tinplate scrap	Quantity (long tons)	Value (thousands)
	Value (thousands)	Quantity (long tons)	Value (thousands)	Value (thousands)		
1972	$6,501	1,304	$2,140	$3,392	152	$477
1973	6,956	1,281	1,322	3,262	154	645
1974	9,331	1,761	1,186	5,950	186	1,316

Table 13.—U.S. imports for consumption of tin, by country

Country	1973		1974	
	Quantity (long tons)	Value (thousands)	Quantity (long tons)	Value (thousands)
Concentrates (tin content):				
Bolivia	[r] 4,782	$18,465	5,877	$35,999
South Africa, Republic of	(1)	(1)	--	--
United Kingdom	16	46	--	--
Total	[r] 4,798	18,511	5,877	35,999
Metal:[2]				
Australia	1,963	8,261	396	2,487
Belgium-Luxembourg	118	521	10	92
Bolivia	832	3,821	1,135	8,571
Brazil	594	2,676	1,238	8,360
Canada	25	109	30	227
China, People's Republic of	1,727	7,801	3,283	9,396
Denmark	--	--	25	206
France	--	--	10	95
Hong Kong	172	720	25	209
India	10	43	--	--
Indonesia	2,829	12,016	4,120	30,340
Japan	--	--	202	1,692
Malaysia	28,255	121,469	20,668	164,154
Mexico	67	136	--	--
Netherlands	45	241	194	1,787
Nigeria	105	419	521	4,521
Switzerland	--	--	30	247
Taiwan	251	1,085	115	663
Thailand	7,964	32,164	5,766	41,500
United Kingdom	888	3,764	1,834	15,095
Total	45,845	195,246	39,602	289,592

[r] Revised.

[1] Less than ½ unit.

[2] Bars, blocks, pigs, grain, or granulated.

WORLD REVIEW

INTERNATIONAL TIN AGREEMENT

With the price of tin above the ITC established ceiling price from late 1973 until October 1974, and the buffer stock virtually depleted, the ITC, operating under the Fourth International Agreement (ITA), had little option but to review disposals from the U.S. stockpile or raise the ceiling price during the four sessions of 1974.

At the April meeting, producing nations, citing increased production costs, asked for a 40% increase in the floor price. The consuming nations objected to such a large increase. The meeting was adjourned and reconvened late in May after the consuming nations representatives conferred with their respective governments. A compromise was reached and, effective May 30, the price range was revised as follows:

	Previous range		Revised range	
	M$/picul	U.S. equivalent cents/pound	M$/picul	U.S. equivalent cents/pound
Floor price	635	198	850	265
Lower sector	635–675	198–210	850–940	265–293
Middle sector	675–720	210–224	940–1,010	293–315
Upper sector	720–760	224–237	1,010–1,050	315–327
Ceiling price	760	237	1,050	327

Even with the 38% increase in the ceiling price, the Penang price did not drop below the ceiling price until October 8, after GSA had sold more than 23,000 tons from the stockpile and the ITC had sold 845 tons from the buffer stock up to that period in the year.

Table 14.—Tin: World mine production by country[1]

(Long tons)

Country	1972	1973	1974[p]
North America:			
Canada	[r] 157	130	138
Mexico	[r] 347	287	394
United States	W	W	W
South America:			
Argentina	[r] 550	425	[e] 390
Bolivia[2]	[r] 30,986	29,838	29,032
Brazil	[r] 3,732	3,682	[e] [3] 3,750
Peru (recoverable)	[r] 124	218	[e] 230
Europe:			
Czechoslovakia	157	[e] [3] 150	141
France	308	306	140
Germany, East[e]	[4] 1,000	1,100	1,100
Portugal	520	525	426
Spain	378	343	422
U.S.S.R.[e]	28,500	29,000	29,500
United Kingdom	3,274	3,723	3,188
Africa:			
Burundi	110	[e] [3] 100	[e] [3] 100
Cameroon	24	[e] [3] 35	[e] [3] 35
Morocco	[r] 12	15	4
Niger	[r] 90	92	78
Nigeria	6,625	5,736	5,369
Rhodesia, Southern[e] [3]	[r] 590	[r] 590	590
Rwanda[e] [3]	1,300	1,300	1,280
South Africa, Republic of	2,125	2,634	2,436
South-West Africa, Territory of (recoverable)	979	779	[e] 740
Tanzania	51	23	11
Uganda	79	43	196
Zaire	[r] 5,866	5,353	4,314
Zambia	[e] [3] 24	[e] [3] 24	11
Asia:			
Burma	[r] 666	601	567
China, People's Republic of[e]	20,000	20,000	20,000
Indonesia	20,992	21,945	24,626
Japan	859	796	539
Korea, Republic of	1	8	14
Laos	[r] [e] 570	[r] [e] 550	585
Malaysia	[r] 75,619	71,121	67,048
Thailand	21,723	20,591	20,018
Vietnam, North[e]	190	190	240
Oceania: Australia	[r] 11,808	10,105	9,990
Total	[r] 240,331	232,358	227,642

[e] Estimate. [p] Preliminary. [r] Revised. W Withheld to avoid disclosing individual company confidential data.

[1] Data derived in part from the Statistical Bulletin of the International Tin Council, London, England.

[2] Total of COMIBOL output, COMIBOL purchases from lessees operating in COMIBOL mines, and medium and small mines' sales to ENAF plus their exports.

[3] Estimate by International Tin Council.

[4] Estimate according to the 60th annual issue of Metal Statistics (Metallgesellschaft).

Table 15.—Tin: World smelter production by country [1]

(Long tons)

Country	1972	1973	1974 [p]
North America:			
Mexico	348	287	394
United States [2]	[r] 4,200	4,800	6,000
South America:			
Bolivia [3]	[r] 6,453	6,757	6,938
Brazil	3,526	[e,4] 4,360	[e,4] 4,770
Europe:			
Belgium	3,861	3,611	3,364
Czechoslovakia	88	[e] 90	[e] 90
Germany, East [e]	[5] 1,100	1,100	1,100
Germany, West	845	1,022	1,362
Portgual	596	516	443
Spain	4,206	4,191	6,063
U.S.S.R. [e]	28,500	29,000	29,500
United Kingdom	20,996	17,391	11,894
Africa:			
Morocco [e,4]	12	12	12
Nigeria	6,637	5,889	5,486
Rhodesia, Southern [e,4]	[r] 590	[r] 590	590
South Africa, Republic of	767	860	[e] 840
Zaire	1,378	954	617
Asia:			
China, People's Republic of [e]	20,000	20,000	20,000
Indonesia	11,819	14,401	14,828
Japan	1,329	1,329	1,307
Laos [e]	[r] 520	[r] 500	530
Malaysia [6]	[r] 89,565	81,166	83,061
Thailand	21,929	22,565	19,514
Vietnam, North [e]	150	150	190
Oceania: Australia	6,916	6,795	6,608
Total	[r] 236,331	228,336	225,501

[e] Estimate. [p] Preliminary. [r] Revised.

[1] Data derived in part from the Statistical Bulletin of the International Tin Council, London, England.

[2] Includes tin content of alloys made directly from ores.

[3] Tin content of production from Metabol and Pero smelters plus exports by ENAF smelter.

[4] Estimate by International Tin Council.

[5] Estimate according to the 60th annual issue of Metal Statistics (Metallgesellschaft).

[6] Includes small production of tin from the smelter in Singapore.

Australia.—According to a study by the Australian Bureau of Mineral Resources, Geology, and Geophysics, Australia's tin reserves increased from 84,000 tons in 1965 to 326,000 tons in 1973. The reserves could be further increased by improving tin recovery rates from alluvial deposits and sulfide ores, recovery of tin from tailings dumps and complex ores, geochemical and geophysical survey methods for tin, and offshore mining methods.[4]

The Australian Government sold its entire strategic stockpile of tin early in the year because of the world shortage of tin and because Australia has become self-sufficient in tin. Associated Tin Smelters Pty. Ltd. purchased the 400-ton stock which offset its production losses due to labor difficulties during the year.

Renison Ltd., Australia's largest tin producer, started operation of its new heavy-media separation plant, thus increasing mill throughput from 450,000 to 700,000 tons per year. Renison and Consolidated Gold Fields, Australia, Ltd., continued exploration of Tasmania's Mount Lindsay tin prospect during the year.

The Aberfoyle group, consisting in part of Aberfoyle Ltd., Ardlethan Tin N.L., and Cleveland Tin N.L., diversified its exploration efforts in an attempt to reduce its heavy dependence on the price of tin. An exploration group formed by the Aberfoyle group and Cominco Exploration Pty. investigated a copper, lead, zinc prospect in southwest Tasmania.

Reserves discovered by exploration at Ardlethan and Cleveland more than offset the amount of ore mined during the year but increased production costs necessitated the exclusion of 1.5 million tons of previous ore reserves as uneconomic. Reserves for the group were placed at 5.6 million tons of ore containing 41,000 tons of tin compared with 7.0 million tons of ore containing 52,000 tons of tin in 1973.

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[4] Phillips, W. G. B., and J. Ward. Australia's Tin Resources. 4th World Conf. on Tin, Kuala Lumpur, Malaysia, Oct. 30–Nov. 5, 1974. International Tin Council, London, England, Paper No. 1.2, 14 pp.

At midyear, Metals Exploration N.L. ceased tin mining at its Gibsonvale, New South Wales, alluvial tin mine following exhaustion of payable reserves. The mine and plant were placed on a care and maintenance basis until tin prices rise enough to resume production.

Bolivia.—Of the 29,032 tons of tin-in-concentrate produced in 1974, COMIBOL contributed 19,726 tons, the medium miners 6,439 tons, and the small miners 2,867 tons. Total tin exports were 28,497 tons, 2% over the 1973 level. Empresa Nacional de Fundiciones (ENAF), the national smelting company, increased its metallic tin exports from 6,304 tons in 1973 to 6,938 tons in 1974.

The Bolivian Government reduced royalties on tin exports following a 25% wage increase for tin miners. The private mines objected to the new royalty schedule because the rates are based on c.i.f. market quotes and charged to all exporters, even if they were experiencing losses. The private mines requested a tax based on profits rather than export tonnages. High duties and low returns on capital were cited as reasons for lack of investment in tin mining over the past several years, as reflected in the overall decline in Bolivian tin production.

A $600,000 mineral concentrating plant, under construction at Quime, was scheduled to start operation January 1975. The plant was expected to bring many idle private mines back into operation by upgrading low grade concentrates to secure acceptance in the world market. Badly needed financial aid for the private mines was furnished by a $6 million World Bank loan. The money was used to upgrade existing mines and appraise their resources.

A $24 million line of credit from 12 European banks will be used for projects to increase production at several COMIBOL mines. Installation of tin preconcentration plants, application of new technology to increase tin recovery from ores and tailings, and improvements in transportation, ventilation, and electrical systems were some of the projects specified. A portion of the funds will be used to increase by 30% the output of the Caracoles mine, the site of one of the richest tin lodes found in Bolivia in recent years. A crosscut about 7,000 feet long, connecting two sections of the mine through unexplored ground, cut 16 tin veins. Production at the mine in 1974 was about 1,400 tons and reserves at yearend were 14,500 tons.

Brazil.—About two-thirds of Brazil's tin output was mined in the Rondônia tin district, which includes all of Rondônia plus portions of the adjoining States of Amazonas and Mato Grosso. Mines in Goiás and Minas Gerais supplied the majority of the remainder with small amounts mined in Pará, Rio Grande do Sul, and Amapá. All the tin was produced from placer deposits. Tin reserves were estimated at 120,000 to 130,000 tons in Rondônia and 66,000 tons in the remainder of Brazil. Extensive undiscovered resources of tin possibly exist in southern Rondônia, Mato Grosso, southern Amazonas, Goiás, and southern Pará. Minor occurrences are found in Amapá, Paraíba, Rio Grande do Norte, Ceará, Bahia, Minas Gerais, São Paulo, and Rio Grande do Sul.

The Government stimulated multimillion dollar investment in tin exploration and mining by: Outlawing production by individual prospectors in Rondônia in favor of mechanized operations; increasing the Government controlled tin-in-concentrate price to 85% of the previous month's LME average price; and improving transport infrastructure in western Brazil making western mines more accessible to smelters in the southeast. Through August, the Government had granted 1,488 exploration licenses and 35 mining concessions covering over 150 square miles. The proliferation of mining companies occurred because of the small area allotted for each exploration license.

Although six mining groups consisting of 102 companies were active in the Rondônia area, four groups accounted for virtually all the production. The Mineração Brumadinho Ltda. group, the largest producer, was 60%-owned by Brazilian cement interests and 40% by NL Industries, Inc. The group controlled 17 mining companies, three of which were actively mining in the following five locations: Oriente Novo, São Domingos do Alto Candeias, São Lourenço, Cachoeirinha, and Macisa. Mineração Oriente Novo S.A., a subsidiary of Mineração Brumadinho, will take delivery of a 3-cubic-foot bucket dredge manufactured by IHC Holland early in 1975. The dredge will be installed in the Cachoeirinha area. The Cachoeirinha pilot plant produced about 5 to 10 tons of concentrate per month but with the installation of the new dredge, production could reach 100 tons per month. Output at the Oriente Novo mine was about 135 tons per month, the São Lourenço produced about 60 tons per month, and the Alto Candeias and Macisa mines produced about 20 tons of concentrate per month.

The Paranapanema S.A. group, controlled by a São Paulo businessman, has eight registered mining companies, two of which were mining and six were prospecting. The group's mines at Massangana and Igarapé Preto each produced about 100 tons of concentrate per month.

The Cesbra/Philipp Brothers group, owned 50% by Cia. Estanifera do Brazil (Cesbra), (in which Patino N.V. recently increased its ownership from 33% to 90.8%), and 50% by a Brazilian subsidiary of Philipp Brothers, had 15 mining companies, only 1 of which, Mineração Brasiliense (Mibrasa), was actively mining. Mibrasa operated the only tin mining dredge in Brazil at the Santa Barbara mine. The dredge had produced up to 100 tons per month but production tapered off to 20 to 35 tons per month due to poor ground conditions and lack of rain. In 1975, the dredge will be moved to a new deposit in the Alto Candeias region of southern Rondônia where production of 50 tons per month was anticipated.

The fourth group, Mineração e Prospecoẽs Minerais S.A., owned 60% by a Canadian firm and 40% by a Brazilian company, formed six mining companies, one actively mining, and five prospecting. The Jacunda mine produced about 400 tons of concentrate during the first 8 months of the year. Treatment plants had a capacity of up to 60 tons per month.[8]

Indonesia.—With production of 24,626 tons, 12% above the 1973 level and the highest output since 1957, Indonesia's mine production continued to resist the downward production trends evident with other major world producers. Continued increases in tin output were stressed in Indonesia's second 5-year plan ending in 1979. To attain the increased output, P.N. Timah, Indonesia's State tin mining enterprise, ordered two new seagoing bucket dredges, scheduled to be in operation by 1977. Both dredges will be capable of dredging to 150 feet, have 22-cubic-foot buckets, maximum throughput of 1,275 cubic yards per hour, and about 7 million cubic yards per year capacity based on a 600-hour working month and buckets dredging at 75% capacity. P.N. Timah operated 28 dredges, 5 seagoing, about 300 gravel pumps, and 1 open pit mine during 1974.

P.T. Broken Hill Pty. Indonesia secured an exploration concession at the Kalapa Kampit lode mine in 1971. Dewatering of the mine commenced in 1974 and mining of bulk samples was to start early in 1975. Broken Hill has allocated $3.75 million to the exploration and evaluation program.

Expansion of the Peltim smelter at Mentok scheduled for completion by yearend 1975 involved the addition of three reverberatory furnaces with a new metal refining section. Capacity will increase 18,000 tons to a total of 33,000 tons per year, enabling Indonesia to smelt all its mine output. Concentrate in excess of Peltim capacity was smelted in Malaysia.

Malaysia.—Malaysia continued to lead the world in production, smelting, and exports of tin in 1974. A total of 67,048 tons of tin-in-concentrate was mined, the lowest level since 1965 and down 6% from the 1973 production because of depletion of tin deposits and higher mining costs. At yearend there were 56 tin dredges, 932 gravel pump mines, and 37 opencast, underground, and other miscellaneous mines in operation, reflecting a 5% increase in total active mines through the year. Gravel pump operations, worked for the most part by the same families that own the mines, accounted for 53% of the concentrates produced, while dredging by corporations furnished another 33%. Opencast mines brought in 4% of the ore produced; underground mines accounted for 4% and the remaining 6% came from miscellaneous sources. The tin mining labor force increased 6% to 44,050 workers at yearend.

Metal production, at 83,061 tons was 2% above the 1973 level. Exports of metal increased to 83,878 tons from 79,958 tons in 1973.

In a move to increase domestic control over its economy and correct racial economic imbalance, the Malaysian Government announced a policy of regulating foreign investment in future mergers and takeovers. The goal for the tin industry would be 70% domestic ownership by 1990. The Malay national's (*Bumiputra*) share will be increased from 2% to 30% with the Chinese and Indian share at 40% and foreign ownership at 30%. Tin production has been dominated by Chinese-owned gravel pumps and European-controlled dredging operations. No takeovers or expropriations were envisioned. *Bumiputra* will secure a larger share of new mining areas for gravel pump ventures. The flow of foreign investment capital into the Malaysian economy will continue to be promoted to supplement capital requirements for rapid development.

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[8] U.S. Embassy, Rio De Janeiro, Brazil. State Department Airgram A-09, Jan. 30, 1975, 22 pp.

In April the Government imposed a variable surcharge on tin as part of a broad-based anti-inflation program. The tax ranged from 0% to 5% depending upon the price, starting when the price went above M$700 per picul (218 cents per pound) and increasing to 5% when the price went above M$1,200 per picul (374 cents per pound).

Perbadanan Nasional Bhd. (Pernas), Malaysia's national mining corporation, announced two tin finds, one off the coast of Malacca and the other offshore from Perak, in its 16,000-square-mile concession off Malaysia's west coast. The size of the finds was not published although the Malacca find was termed "substantial." Further drilling was undertaken to establish the size of the Perak deposit. Pernas was negotiating with overseas companies to exploit the deposits.

A $500,000 feasibility survey of Selangor's Kuala Langat forest reserve indicated rich, deep-seated deposits spread over 40,000 acres. Many deposits occur below 200 feet, well below the maximum operating depth of existing dredges, indicating that the mining of the deposits will cost more than mining the shallow alluvial deposits of the Kinta Valley, the area contributing most to Malaysia's tin output during this century. Four dredges operated in the Kuala Langat district at yearend. Selangor Dredging Bhd. operated two dredges and Petaling Tin Bhd. and Conzinc Riotinto Malaysia Sdn. Bhd. each operated one dredge. The Selangor State Government planned to operate three dredges in the area, the first, costing over $5 million, to go into operation in mid-1976.

Pahang State made available 240,000 acres for tin prospecting in the Pahang Tenggara Development area. The State of Kelantan signed an agreement with Anglo-Oriental (Malaya) Sdn. Berhad for mineral prospecting of an area larger than 50,000 acres. Kelantan has not been a major mining state in Malaysia.

Production of tin-in-concentrate by Berjuntai Tin Dredging Bhd. increased 7% to 3,701 tons during its fiscal year. Building of the No. 8 dredge continued on schedule with a launching of a pontoon in November. The dredge will replace the No. 1 dredge which has been operating in Selangor for about 50 years. The estimated cost of the dredge, at $7 million, was about half the total cost for the seven other dredges the company owned.

Southern Kinta Consolidated Ltd., with output of about 1,600 tons of concentrate in 1974, was refused renewal of a mining title to 100 acres of the Rasa Section in Selangor by the Selangor State Government. Upon appeal, Southern Kinta was informed that the title had been granted to another company. The dredgeable portions of the area would have provided up to 2 years of production for the Rasa dredge.

Tronoh Mines Ltd. and Perak State Development Corp. (PSDC) formed a joint venture to exploit tin reserves in the Batang Padang area adjacent to Tronoh's existing leases. The company, owned 70% by Tronoh and 30% by PSDC, was the first joint venture between the private sector and a State government. A dredge of 800,000-cubic-yard-per month capacity will be ordered to mine the area estimated to have reserves of 122 million cubic yards grading 0.27 pound per cubic yard.

Tronoh later was included in another joint venture in which the Selangor State Development Corp. holds 55%, Charter Consolidated (Malaysia), Sdn. Berhad, 36%, and Tronoh 9%, that will develop deep-seated reserves in southern Selangor. Substantial work will be necessary to complete a feasibility study and mining plan but if findings are acceptable, mining operations could start in 5 years.

Gopeng Consolidated Ltd. acquired 550 acres of mining land in the Mukim, Chenderiang District of Batang Padang, Perak, subject to 30% *Bumiputra* participation required by Malaysia's new economic plan. The need to replenish reserves was evident from Gopeng's declining production, down 12% from the 1973 level, to 2,377 tons of concentrate in 1974.

Conzinc Riotinto Malaysia, a joint venture between Rio Tinto-Zinc (41.25%), Conzinc Riotinto of Australia Ltd. (13.75%), and Bethlehem Steel Corp. (45%), experienced numerous production problems with its new dredge requiring modifications to the treatment plant and design of the dredge itself. Production for 1974 was 350 tons short of its designed capacity of 1,000 tons of concentrate per year.

Pacific Tin Consolidated Corp., the only U.S. company mining tin in Malaysia, showed decreases in total yardage treated and tin recovered in 1974. Dredge No. 8 was shutdown from May to November due to structural failure and collapse of the dredge's digging ladder.

Syarikat Eastern Smelting Bhd. will move its smelting facilities from Penang Island to the mainland. Although the move would allow expansion of the facilities, the main reason for the move was to allow redevelopment of the present 13-acre site into a building complex.

Nigeria.—Production of tin in Nigeria declined for the sixth consecutive year to 5,369 tons in 1974, the lowest level since 1934. Over the past several years, spiraling production costs had lowered the profit margin of operators to a point where significant reinvestment and exploration programs had to be curtailed, forcing rapid depletion of minable ore bodies. Decreased royalties and high prices through the middle of the year gave operators a much needed opportunity to make a profit.

Amalgamated Tin Mines of Nigeria (Holdings) Ltd., Nigeria's largest producer, increased profits to $4.35 million during its fiscal year ending March 1974 compared with $0.99 million in 1973. Over $1.5 million of the profits was invested in much needed earth-moving equipment, two bucket wheel excavators, to begin operation in 1975. The investment, one of the largest in the Nigerian tin industry in many years, could be a precursor to increased mechanization of tin mining. Rising labor costs are forcing mechanization if the mines are to remain competitive in the international market.

South Africa, Republic of.—Rooiberg Minerals Development Co. Ltd. announced plans to open an underground mine at Vellefontein in the Transvaal. Reserves at the new lode mine were estimated at 600,000 tons with an average head grade of 0.7% tin. Development costs will be over $2 million with production to start in 1977. Another $500,000 will be spent increasing capacity at Rooiberg's "C" mine. Rooiberg was also considering construction of a new smelter with enough capacity to smelt the total mine output of the Republic of South Africa and of the Territory of South-West Africa.

Thailand.—Depletion of onshore reserves and increased mining costs caused Thailand's tin production to decline 3% from the 1973 level to 20,018 tons in 1974. Although mining activity increased during the year to a total of 685 mines in operation at yearend, productivity declined. There were 22 dredges, 310 gravel pump and hydraulic operations, and 353 other mines producing tin at yearend. Gravel pump and hydraulic mines provided 47% of the output while dredges provided 33%.

An alluvial deposit off the West Coast of Thailand was discovered by the Boonsoong Tin Dredging Co. and Leighton Mining Co. Indicated reserves of 40 million cubic yards grading 0.34 pound of tin per cubic yard were claimed. No development plans will be made until completion of exploration in mid-1975.

United Kingdom.—Decreased output from Wheal Jane Ltd. was attributed to lower grade ore and lower recovery rates. Wheal Jane, the largest tin producer in the United Kingdom, treated 202,000 tons of ore, recovering 1,457 tons of tin-in-concentrate compared with 1,585 tons in 1973.

Geevor Tin Mines Ltd. increased its tin metal reserves 425 tons to 3,398 tons but its average recovery of tin concentrate per ton of ore treated dropped to 18 pounds during the 6-month period ending September compared with 23 pounds during the corresponding period in 1973.

Marine Mining (Cornwall), Ltd., a subsidiary of Marine Mining Corp. of New Jersey, applied for a lease to mine offshore alluvial deposits in the St. Agnes region. Mining will take place from a mobile platform resting on the seabed. Primary dressing by a wet gravity concentrator will take place on the platform with final treatment to take place onshore.

Zaire.—Zairetain, 50% owned by the

Zairian Government and 50% by Compagnie Géologique et Minière des Ingénieurs et Industriels Belges (Géomines), expanded capacity at its Manono mine to 100 tons of concentrate per month by mid-1974. Expansion to 150 tons per month will be completed in 1975 by recommissioning a washing plant. The mine has reserves for 3 to 4 years of operation at the higher rate. Additional resource evaluation to extend operations would require substantial external capitalization. Production has declined from 2,155 tons of concentrate in 1971 to 973 tons in 1974.

A three-phase plan to merge the tin-mining companies in Kivu Province passed into the second phase when Cobelmin Zaire, a subsidiary of Compagnie Belge d'Entreprises Minières, began administration of Kivumines, Philipp Brothers Sobaki (Phibrake), and Somikubi early in the year. The third phase, to take place in 1975, will bring Syndicat Minière de l'Etain (Symetain) into the merger. Zairian Government participation in the new organization, tentatively to be named Société Minière et Industrielle du Kivu (Sominki), was expected.

TECHNOLOGY

The Fourth World Conference on Tin, organized by the ITC and the Ministry of Primary Industries, Malaysia was held in Kuala Lumpur from October 30 to November 5, 1974. Over 30 papers were presented on subjects ranging from world tin resources, prospecting, mining and processing, and smelting to marketing and consumption of tin. The need to improve resource data and recovery from ores presently mined, especially sulfide ores, and to advance onshore and offshore prospecting and offshore mining methods were stressed. A new method of smelting low-grade concentrate was discussed and trends in consumption and aspects of tin marketing were reviewed. Full proceedings of the conference will be published by the ITC.

The Australian Tin Information Center, the ninth overseas office of the Tin Research Institute (TRI), was officially opened in April. Australia is unique among the major tin-consuming countries because it is also a significant tin producer. The TRI Australian office will provide the technological linkage between producer and consumer as well as the interdisciplinary expertise necessitated by the diversity of tin applications.

A British patent was issued for a pretreatment process to improve froth flotation of tin ore.[6] A relatively low cost collector reagent for the froth flotation beneficiation of cassiterite has been developed.[7]

Kivcet, a Soviet acronym for a oxygen-flash-cyclone-electrothermic smelting process developed in the Soviet Union, has been licensed to a West German firm for use in Western countries.[8] The process is suited to one-step, continuous smelting of complex sulfide concentrates containing copper, lead, zinc, nickel, and other metals such as tin and cadmium. The process is said to have many advantages. If the concentrate contains more than 20% sulfur, the roasting-smelting reaction is autogeneous, actually having a net heat surplus, thus requiring less fuel, electrical energy, and oxygen per ton of charge. During autogeneous smelting the low-volume off-gases are highly concentrated in SO_2 which may be converted directly to elemental sulfur or sulfuric acid. Metal recovery in the matte is very high and the slag is discarded directly from the system because the settling action in the electrical furnace helps free entrained matte from the slag layer.

With an average annual growth rate of 7% to 8%, world consumption of tin in chemicals has increased more rapidly than in any other area over the past 25 years. The TRI reviewed recent developments in organic and inorganic tin compunds.[9] Triorganotin compounds, known for antimicrobial action, have found increasing applications in antifouling paints, timber preservation, and agricultural chemicals. Diorganotin compounds are especially important as stabilizers for polyvinyl chloride and as catalysts in the production of polyurethane foams. Direct uses of inorganic tin compounds in the ceramics and glass industries and as inorganic tin catalysts, as opposed to indirect uses such as those in the electrolyte solution for tin and tin alloy plating or as intermediates in organotin production, account for most of the tin consumed in inorganic chemicals.

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[6] Wottyen, E., C. Neuber, and D. Luft (assigned to VEB Bergbau-und Hüttenkombinat "Albert Funk"). Treatment of Tin Ore to Improve the Subsequent Froth Flotation Beneficiation Thereof. British Pat. 1,353,861, May 22, 1974.

[7] Verheyden, A., and J. Hartmann (assigned to Citrex, S.A.). New Collector Reagent for Use in the Froth Flotation Beneficiation of Cassiterite, Columbium-Tantalum Ore, Fluorspar, Barite, Lead-Zinc Oxide Ore, Copper Oxide Ore, Iron Oxide or Other Oxide or Mineral Salt Ores. U.S. Pat. 3,822,014, July 2, 1974.

[8] World Mining. Kivcet Process for Complex Ores. V. 10, No. 6, June 1974, pp. 27–28.

[9] Evans, C. J. Developments in the Organotin Industry. Tin and Its Uses. Quart. Rev. Tin Res. Inst., pt. 1, No. 100, 1974, pp. 3–6; pt. 2, No. 101, 1974, pp. 12–15; Tin Res. Inst. Pub. No. 491.

Fuller, M. J. Industrial Uses of Inorganic Tin Chemicals. Tin and Its Uses. Quart. Rev. Tin Res. Inst., No. 103, 1975, pp. 3–7.

Hull fouling costs the U.S. Navy $70 million in added fuel costs per year.[10] Over the life of a ship, 25% of the fuel costs for operating the ship is linked to hull fouling. To prevent hull fouling and to lessen the frequency of hull maintenance, the U.S. Navy has been experimenting with organometallic polymers, the most promising of which appear to be the copolymers of tri-n-butyltin or tri-n-propyltin and methacrylate. In tests at Pearl Harbor, the tri-n-butyltin/tri-n-propyltin methacrylate was still effective against fouling organisms after 3 years in the water.

Research conducted at a U.S. university using triphenyltin acetate and chloride to inhibit the growth of tumors in mice has established that triphenyltin acetate has promise as a potential tumor growth inhibitor.[11]

A new, white metal-bearing alloy has been developed which is claimed to have higher strength, better bonding properties, less sensitivity to cooling rates, less tendency to segregate, superior ductibility, and good machinability.[12] New, stronger, and lower cost alloys for making relays, connectors and springs were developed by a U.S. firm.[13] The copper, nickel, and tin alloys can be 15% stronger and sustain a 40% greater load under repeated bending than copper beryllium, the strongest copper alloy currently used.

A lead-bismuth alloy continuing up to 10% tin was developed for soldering aluminum.[14]

After up to 20 years of observation, the TRI has shown that by careful selection of type and thickness of coating, by choice of substrate, and by various other methods, the risk of spontaneous growth of whiskers on tin coatings can be greatly reduced.[15] Recent developments in tin nickel plating and drawn and wall-ironed can manufacture were reviewed by the TRI.[16]

A new float glass process that allows the glass to be formed at the refining stage before passing over a tin bath, resulting in glass of more uniformity, has been developed by a U.S. firm.[17]

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[10] Murray, C. Organometallic Polymers Targeted at Barnacles. Chem. & Eng. News, v. 53, No. 1, Jan. 6, 1975, pp. 18–19.

[11] Tin News. Tin-Novations. V. 23, No. 9, Sept. 15, 1974, p. 6.

[12] Quarterly Review, Tin Research Institute. Tin and Its Uses. A New Whitemetal Bearing Alloy. No. 103, 1975, p. 9.

[13] Chemical & Engineering News. New Copper Alloys Are Strong, Low Cost. V. 52, No. 42, Sept. 30, 1974, p. 5.

[14] Tin International. Developments in Tin Alloys. V. 47, 1974, p. 330.

[15] Britton, S.C. Spontaneous Growth of Whiskers on Tin Coatings: 20 Years of Observation. Tin Res. Inst. Pub. No. 487; Trans. Inst. Metal Finishing, v. 52, 1974, pp. 95–102.

[16] Barry, B. T. K., and C. J. Evans. D & I Cans— A Can—Making Revolution. Tin and Its Uses. Quart. Rev. Tin Res. Inst., No. 100, 1974, pp. 12–15.

Quarterly Review, Tin Research Institute. Tin Nickel Plating Today. No. 102, 1974, pp. 3–5.

[17] Tin International. New "Float Glass" Process. V. 48, No. 4, 1975, p. 124.

Titanium

By F. W. Wessel [1]

Demand for titanium in its various forms began to decrease during the second half of 1974. Production of pigment during the fourth quarter was 19% below the record high of 216,218 tons produced during the second quarter. Demand from the larger pigment consumers began to decline as early as March. Ingot production held up well during the year, but the backlog of orders for titanium mill products became less. Domestic ore shipments declined about 7%.

Prices moved up sharply during the first half and held at high levels until yearend. The price of pigment was decontrolled April 1, after which it joined other titanium commodities in an upward movement.

Legislation and Government Programs.—About 16,000 tons of rutile was sold from the stockpile early in the year, leaving 39,000 tons on hand. Stockpiled titanium sponge continued to be sold under the "buy-back" provisions of its acquisition to RMI Co. and Titanium Metals Corp. of America (TMCA), its original producers.

The Environmental Protection Agency (EPA) published guidelines for effluent limitations in terms of iron content, acidity, and total suspended solids. A few months later, EPA published a notice of intent to amend these guidelines.[2] An EPA report that included a study of 23 inorganic chemicals, including titanium dioxide, indicated that costs of waste treatment could be passed along to the consumer. In the case of titanium dioxide, such costs would bring about price increases ranging from 0% to 20%.[3]

Table 1.—Salient titanium statistics

	1970	1971	1972	1973	1974
United States:					
Ilmenite concentrate:					
Mine shipments short tons	920,964	713,610	743,401	813,400	755,299
Value thousands	$18,626	$15,936	$17,234	$21,041	$22,715
Imports short tons	96,123	28,093	14,836	69,691	82,448
Consumption do	972,314	898,783	786,384	807,733	851,977
Titanium slag:					
Imports do	134,996	152,661	298,259	237,248	236,272
Consumption do	129,247	143,554	264,095	281,791	257,125
Rutile concentrate, natural and synthetic:					
Imports do	243,259	227,784	r 220,533	208,808	235,507
Consumption do	189,172	225,498	242,758	276,907	292,661
Sponge metal:					
Imports for consumption do	5,931	2,802	3,808	5,172	6,963
Consumption do	16,414	12,145	13,068	20,173	26,896
Price per pound on December 31	$1.32	$1.32	$1.32	$1.42	$2.25
World production:					
Ilmenite concentrate short tons	3,109,151	2,845,789	r 2,702,398	r 2,978,048	3,148,787
Titanium slag do	853,389	859,097	r 924,084	r 947,394	936,025
Rutile concentrate, natural do	459,507	423,825	r 351,380	r 374,445	369,117

r Revised.

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[1] Physical scientist, Division of Nonferrous Metals.

[2] Federal Register. V. 39, No. 49, Mar. 12, 1974, pp. 9624–9625; v. 39, No. 154, Aug. 8, 1974, p. 28536.

[3] Environmental Protection Agency. Economics of Clean Water—1973. December 1973, 120 pp.; available from the U.S. Environmental Protection Agency, Washington, D.C. 20460.

A bill to suspend the 7.5% ad valorem tariff on synthetic rutile became law in October.

Government exploration assistance for rutile, available through the Office of Minerals Exploration, U.S. Geological Survey, remained at 75% of the approved cost of exploration. The depletion allowance for ilmenite and rutile remained at 22% for domestic deposits and 14% for foreign deposits.

DOMESTIC PRODUCTION

Concentrates.—Production and shipments of titanium-mineral concentrate in 1974 decreased 5.2% and 7.1%, respectively; the quantity of TiO_2 shipped decreased 6.0%. Rutile production was 6,266 tons, a decrease of 32.3% from that of 1973. The average grade of concentrate shipped was 57.4%, unchanged from 1973. Increased production from the American Smelting and Refining Co. (ASARCO) mine, Ocean County, N.J., was more than offset by decreased production at the mines of NL Industries, Inc., Tahawus, N.Y.; Titanium Enterprises, Green Cove Springs, Fla.; and Humphreys Mining Co. Humphreys interrupted production to move its dredge and rough concentration plant from the worked-out deposit at Folkston, Ga., to a new deposit at Boulogne, Fla. In moving to Boulogne, the company left its dry mill at Folkston; rough concentrates are trucked 13 miles to Folkston for finishing. Production continued with little change at the mines of E.I. du Pont de Nemours & Co., Starke and Highland, Fla.; and SCM Corp., Glidden-Durkee Div., Lakehurst, N.J.

Reserves at ASARCO's New Jersey deposit were estimated at more than 100 million tons of sand containing 4% heavy minerals.

Table 2.—Production and mine shipments of titanium concentrates[1] from domestic ores in the United States

Year	Production (short tons, gross weight)	Shipments		
		Short tons (gross weight)	TiO_2 content (short tons)	Value (thousands)
1970	867,955	920,964	487,298	$18,626
1971	683,075	713,610	388,802	15,936
1972	695,727	743,401	420,887	17,234
1973	785,268	813,400	467,091	21,041
1974	744,572	755,299	433,310	22,715

[1] Includes a mixed product containing rutile, leucoxene, and altered ilmenite.

Ethyl Corp. held about 2,000 acres of land under lease near Paris Landing in western Tennessee, where the McNairy formation contains ilmenite, rutile, zircon, and monazite. During 1974, the company conducted a pilot operation to obtain process data on the mining and beneficiation of these minerals. The pilot plant operates at about 5 tons per hour, and uses flotation to make a bulk concentrate to send to a conventional dry plant. The test program was to be completed by yearend; however, the company delayed its decision pending completion of the dry-plant test work and the results of further study of the effects of dredging on ground water. The project continued to be opposed by environmental groups, but the company's final decision was expected during the last half of 1975.

Ferroalloys.—Production of ferrotitanium was higher than that of 1973, and was produced solely by Shieldalloy Corp., Newfield, N.J. As in 1973, higher grade alloys accounted for about 75% of the total produced.

Metal.—Production of titanium sponge exceeded that of 1973 by 17.5%; in addition, 5,700 tons was received from the Federal stockpile by the original producers under a "buy-back" provision. Producing companies were TMCA, Henderson, Nev., owned by NL Industries, Inc., and Allegheny Ludlum Steel Corp.; and RMI Co., Ashtabula, Ohio, owned by National Distillers & Chemical Corp. and United States Steel Corp.

Production of titanium ingot was 36,132 tons, a 25% increase over 1973 levels. As in previous years, the following nine companies produced ingot:

Company	Plant location
Crucible Steel Co. of America	Midland, Pa.
Howmet Corp	Whitehall, Mich.
Martin Marietta Aluminum, Inc.	Torrance, Calif.
Oregon Metallurgical Corp	Albany, Oreg.
RMI Co	Niles, Ohio
Teledyne Titanium, Inc	Monroe, N.C.
Titanium Metals Corp. of America.	Henderson, Nev.
Titanium West, Inc	Reno, Nev.
TiTech International, Inc	Pomona, Calif.

There were indications of decreased demand at yearend, originating mainly in the area of commercial aircraft production.

Table 3.—Titanium metal data

(Short tons)

	1970	1971	1972	1973	1974
Sponge metal:					
Imports for consumption	5,931	2,802	3,808	5,172	6,963
Industry stocks	2,516	2,724	1,816	1,941	3,822
Government stocks (DPA inventories)[1]	19,994	19,994	19,994	18,706	11,897
Consumption	16,414	12,145	13,068	20,173	26,896
Scrap metal consumption	7,242	6,149	7,802	10,038	10,599
Ingot:[2]					
Production	24,331	18,387	20,267	28,932	36,132
Consumption	23,687	17,058	19,499	25,409	31,563
Net shipments of mill products[3]	14,480	11,241	12,627	14,530	17,443

[1] As of June 30 each year.
[2] Includes alloy constituents.
[3] Source: Bureau of the Census, Current Industrial Reports Series BDCF-263.

Pigment.—Production of pigment increased 0.3%. Shipments advanced 10.5% over 1973 levels, in spite of the collapse of the market in the last quarter. Rutile pigment accounted for 75% of total production and was produced by all seven manufacturers. Five companies produced anatase pigment, and a small quantity of composite pigment was made. Companies producing pigment during the year, with plant location and nominal capacity, were as follows, in tons per year:

Company and plant location	Pigment capacity	
	Sulfate	Chloride
American Cyanamid Co.: Savannah, Ga	70,000	40,000
E. I. du Pont de Nemours & Co.:		
Antioch, Calif	--	27,000
Edge Moor, Del	--	112,000
New Johnsonville, Tenn	--	228,000
Kerr-McGee Chemical Co.: Hamilton, Miss	--	45,000
NL Industries, Inc.:		
St. Louis, Mo	108,000	--
Sayreville, N.J	115,000	--
New Jersey Zinc Co.:		
Gloucester City, N.J	42,000	-
Ashtabula, Ohio	--	27,000
SCM Corp. Glidden-Durkee Div.: Baltimore, Md	50,000	25,000
Sherwin-Williams Chemical Co.: Ashtabula, Ohio	--	27,000
Total	385,000	531,000

In October, Sherwin-Williams Chemical Co. announced an agreement to sell its pigment plant to SCM Corp.

In May, Kerr-McGee Chemical Co. announced its purchase of 800 acres of an industrial park near Mobile, Ala., on which it intended to construct (1) a plant to produce 50,000 tons of pigment annually, and (2) a plant to produce 110,000 tons of synthetic rutile per year. The rutile plant was to use imported ilmenite until production begins at the company's mineral lands near Camden, Tenn. The synthetic rutile produced will be fed to the new pigment plant and the company's existing pigment facility at Hamilton, Miss. However, it was understood at yearend that although the synthetic rutile plant was under construction and expected to come on line in late 1976, pigment plant construction has been deferred.

E.I. du Pont de Nemours & Co. took an option on about 2,200 acres of land near DeLisle, Harrison County, Miss., on St. Louis Bay, and began work on a test well for waste disposal. The company abandoned plans to build its fourth pigment facility at Brunswick, Ga., because officials in that State refused approval of the company's deep-well waste disposal plans. The firm must meet strict conditions established by EPA and Mississippi State authorities in order to construct the planned chloride-process plant with a 125,000-ton annual capacity; contracts for some equipment items have already been placed. Construction of an additional 55,000 tons of annual capacity at the du Pont plant at Edge Moor, Del., continued during the year.

Table 4.—Titanium pigment data

(TiO_2 content)

Year	Production (short tons)	Shipments [1]	
		Quantity (short tons)	Value, f.o.b. (thousands)
1970	655,293	643,746	$320,014
1971	677,751	684,698	311,140
1972	718,177	752,025	358,564
1973	r 784,996	p 793,991	p 404,639
1974	p 787,646	NA	NA

p Preliminary. r Revised. NA Not available.

[1] Includes interplant transfers.

Source: Bureau of the Census.

CONSUMPTION AND USES

Concentrates.—Consumption of ilmenite and rutile increased 5% and 6% respectively, over 1973 levels, but slag consumption declined 9%.

Metal.—Consumption of sponge and ingot increased 33% and 24%, respectively. Shipments of mill products were 20% higher than those of 1973. The backlog of unfilled orders for titanium mill products was reportedly decreasing during the last half of 1974. Demand for titanium condenser tubes in both thermal and nuclear powerplants was strong, however, as was demand from the aerospace industry for titanium castings. New uses forecast during the year were in sporting goods and in rechargeable batteries. Scrap consumed for making ingot was 6% higher than in 1973.

Pigments.—Preliminary figures showed a 5.6% increase in shipments. The plastics industry continued to increase its consumption of pigment from 44,500 tons in 1971 to 94,000 tons in 1974. Orders for pigment declined sharply in the final quarter of 1974; consumers were using inventories, with no indication that these inventories had been reduced to a minimum by yearend.

Laboratory investigation indicated a high anatase-pigment content in the ink on an ostensibly 15th century "Vinland map" and helped to establish the map as fraudulent.

Table 5.—Consumption of titanium concentrates in the United States, by product

(Short tons)

Year and product	Ilmenite[1]		Titanium slag		Rutile	
	Gross weight	TiO_2 content[e]	Gross weight	TiO_2 content[e]	Gross weight	TiO_2 content[e]
1970	972,314	519,766	129,247	91,639	189,172	181,402
1971	898,783	486,271	143,554	101,751	225,498	215,916
1972	786,384	461,422	264,095	187,608	242,758	232,231
1973:						
Alloys and carbide	(2)	(2)	(3)	(3)	--	--
Pigments	795,728	470,087	281,791	199,287	232,969	221,658
Welding-rod coatings and fluxes	(2)	(2)	--	--	10,635	10,059
Miscellaneous[4]	12,005	9,144	--	--	33,303	31,648
Total	807,733	479,231	281,791	199,287	276,907	263,365
1974:						
Alloys and carbide	(2)	(2)	(3)	(3)	(2)	(2)
Pigments	839,284	492,206	257,125	182,257	241,003	228,507
Welding-rod coatings and fluxes	(2)	(2)	--	--	11,759	11,181
Miscellaneous[4]	12,693	9,070	--	--	39,899	38,032
Total	851,977	501,276	257,125	182,257	292,661	277,720

[e] Estimate.

[1] Includes a mixed product containing rutile, leucoxene, and altered ilmenite.

[2] Included with "Miscellaneous" to avoid disclosing individual company confidential data.

[3] Included with "Pigments" to avoid disclosing individual company confidential data.

[4] Includes ceramics, chemicals, glass fibers, and titanium metal.

Table 6.—Distribution of titanium-pigment shipments, by industry

(Percent)

Industry	1970	1971	1972	1973	1974
Distribution by gross weight:					
Paints, varnishes, lacquers	59.6	57.7	53.0	52.7	52.6
Paper	17.0	17.8	20.4	19.6	18.5
Floor coverings	1.8	2.1	2.1	1.3	1.6
Rubber	2.6	2.7	3.6	3.2	2.7
Coated fabrics and textiles (oil cloth, shade cloth, artificial leather, etc.)	1.3	1.0	1.5	1.3	1.0
Printing ink	2.2	2.1	2.1	2.0	2.0
Roofing granules	.9	1.0	.3	.6	.4
Ceramics	1.8	2.0	2.3	2.5	2.1
Plastics (except floor covering and vinyl-coated fabrics and textiles)	6.6	6.5	7.7	9.8	11.3
Other (including export)	6.2	7.1	7.0	7.0	7.8
Total	100.0	100.0	100.0	100.0	100.0
Distribution by titanium dioxide content:					
Paints, varnishes, lacquers	55.8	54.4	52.0	52.5	52.5
Paper	19.3	19.7	20.9	19.8	18.7
Floor coverings	2.1	2.4	2.1	1.3	1.6
Rubber	3.0	3.0	3.7	3.2	2.7
Coated fabrics and textiles (oil cloth, shade cloth, artificial leather, etc.)	1.4	1.1	1.5	1.3	1.0
Printing ink	2.5	2.3	2.2	1.9	1.9
Roofing granules	1.0	1.1	.3	.6	.4
Ceramics	2.1	2.2	2.4	2.6	2.1
Plastics (except floor covering and vinyl-coated fabrics and textiles)	7.6	7.1	7.9	9.8	11.3
Other (including export)	5.2	6.7	7.0	7.0	7.8
Total	100.0	100.0	100.0	100.0	100.0

STOCKS

The quantity of rutile in private hands continued to erode during 1974, showing a 27% decrease. Slag inventories were reduced 48%, reflecting the heavy demand and consequent shortages. Ilmenite stocks increased about 1%. Yearend stocks of titanium sponge and scrap increased 97% and 24%, respectively. Industry stocks of various grades of titanium pigment were 88,939 tons at yearend, more than twice the January 1 figure; additions to inventory in November and December totaled 42,000 tons.

Table 7.—Stocks of titanium concentrates in the United States, December 31

(Short tons)

	Gross weight	TiO_2 content [e]
Ilmenite:		
1972	534,504	314,584
1973 [r]	567,826	329,477
1974	572,637	325,943
Titanium slag:		
1972	142,301	100,746
1973 [r]	111,014	78,650
1974	57,932	40,836
Rutile:		
1972	158,106	150,801
1973 [r]	147,691	139,641
1974	107,723	101,301

[e] Estimate. [r] Revised.

PRICES

Concentrates.—Price quotations for ilmenite in domestic markets stood at $38 per long ton until July 1 and at $55 thereafter. Australian ilmenite prices began the year at A$11 to A$12 per metric ton, rose $2 per ton at midyear, and closed in the A$13 to A$15 range. Indian ilmenite sold at £3.95 (US$9.50) per long ton, f.o.b. Indian west coast ports, until May; quotations thereafter were in U.S. dollars, and the price went to $16.50 per long ton. In July, Malayan ilmenite began to be quoted in Australian dollars per metric ton; the price range at that time was A$13 to A$14, but some lots were sold at A$15 before the yearend.

Rutile, bulk, f.o.b. cars at Atlantic, Gulf, and Great Lake ports, began the year at $330 per short ton, rose to the range of $520 to $550 at midyear, and went to $710 per short ton in November. These were spot prices; long-term contracts presumably were negotiated at somewhat lower figures. Corresponding price ranges in Australia, in Australian dollars per metric ton, free in container depot (f.i.d.), rose throughout the year as follows: January 1, $140–$148; January 31, $145–$152; March 12, $165–$180; April 15, $175–$200; May 14, $180–$210; May 31, $200–$240; July 9, $280–$320; and October 4, $290–$330.

Titanium slag remained at $60 per long ton, f.o.b. Sorel, Quebec, throughout the year; however, a 25% price increase was announced, effective January 1, 1975.

Metal.—Domestic sponge began the year at $1.42 per pound. The price increased to $1.50 in February, $1.78 in March, $1.90 in June, and $2.25 in November. Japanese sponge sold in the range of $1.36–$1.38 per pound as the year began, rose to $1.46 per pound in February, to $1.70–$1.75 in March, and to $2 at midyear, at which level it closed the year.

Pigments.—Price increases for the various grades of pigment were few and limited during the first quarter; thereafter, prices were decontrolled by the Cost of Living Council and increased to the range of 26–33½ cents per pound for anatase and 32–38 cents per pound for rutile during the second quarter. In July, further increases took place to the ranges of 30½–38½ and 35–43 cents per pound for anatase and rutile, respectively, and were effective until yearend.

FOREIGN TRADE

Titanium dioxide exports in 1974 amounted to 30,379 tons, a 46% increase over 1973 levels. Of this total, Brazil received 14.6%, other Latin American countries and the West Indies, 23.9%; Japan, 9.8%; the Philippines, 8.7%; other Far East countries, 13.4%; Western Europe, 11.0%; Canada, 8.6%. Exports of unwrought, waste, and scrap titanium were 14% greater than those in 1973; 37% went to the United Kingdom and 32% to Belgium. The average valuation was 98 cents per pound, more than twice that of 1973, indicating increased demand for the better grades of scrap. Exports of wrought titanium (ingots, billets, and mill shapes) were 131% greater than those of the previous year.

Imports of ilmenite from Australia in 1974 doubled for the second successive year. Imports of Sorel slag were essentially unchanged. Imports of rutile were 13% greater than those in 1973. The port districts of New Orleans and Galveston reported receipts of 96,667 tons and 84,885 tons of titaniferous iron ore, respectively.

Table 8.—U.S. exports of titanium products, by class

Year	Ores and concentrates		Metal and alloy sponge and scrap		Intermediate mill shapes and mill products, n.e.c.		Pigments and oxides	
	Quantity (short tons)	Value (thousands)	Quantity (short tons)	Value (thousands)	Quantity (short tons)	Value (thousands)	Quantity (short tons)	Value (thousands)
1972	1,802	$394	3,510	$2,165	562	$6,265	10,335	$4,882
1973	1,494	353	4,142	3,601	745	8,748	20,769	14,021
1974	3,264	727	4,730	9,288	1,719	19,600	30,379	24,575

Imports of unwrought, waste, and scrap titanium were 48% greater than those in 1973. Of the total, 6,963 tons was sponge, which came from Japan (2,753 tons), the U.S.S.R. (3,541 tons), and the United Kingdom (669 tons). The Japanese sponge bore an average declared valuation of $1.17 per pound; the corresponding figure for Soviet sponge was 98 cents per pound. The U.S.S.R. and the United Kingdom were the principal sources of 2,296 tons of ferrotitanium of all grades, valued at $3.12 million.

Imports of pigment reached a total of 34,996 tons, 42% less than in 1973. Imports constituted about 4% of 1974 consumption.

Capacity for titanium pigment production in Western Europe was estimated at 200,000 to 250,000 tons per year in excess of demand. A strong export market kept this condition from being troublesome during most of the year.

A bill (HR 11830) to suspend the duty on synthetic rutile until June 30, 1977, became Public Law 93–470 in October, and a separate Tariff Schedule of the United States (TSUS) category (911.2500) was set up to report imports of this material.

Table 9.—U.S. imports for consumption of titanium concentrates, by country[1]

Country	1972		1973		1974	
	Quantity (short tons)	Value (thousands)	Quantity (short tons)	Value (thousands)	Quantity (short tons)	Value (thousands)
Ilmenite:						
Australia	14,334	$142	29,590	$378	64,506	$1,176
Canada	317	11	172	6	305	12
India	--	--	3,360	30	[2] 17,637	260
Malaysia	[2] 185	2	16,327	224	--	--
Sweden[3]	--	--	20,242	236	--	--
Total	14,836	155	69,691	[4] 875	82,448	1,448
Titanium slag[5]	298,259	13,124	237,248	10,981	236,272	12,267
Rutile:[6]						
Australia	220,025	24,041	174,754	24,378	204,070	33,628
Austria[3]	22	3	--	--	--	--
Canada[3]	20	3	134	18	586	277
Denmark[3]	18	2	20	3	--	--
India	--	--	28,472	2,272	4,409	827
Japan	448	25	5,405	483	26,442	2,713
Malaysia[3]	--	--	23	5	--	--
Total	220,533	24,074	208,808	[4] 27,158	235,507	37,445
Titaniferous iron ore[7]	82,133	954	83,513	1,395	201,256	2,373

[1] Data adjusted by Bureau of Mines, U.S. Department of the Interior.
[2] May have been used in heavy aggregate.
[3] Country of transshipment rather than country of production.
[4] Data does not add to total shown because of independent rounding.
[5] All from Canada.
[6] Includes synthetic rutile.
[7] Includes materials consumed for purposes other than production of titanium commodities, principally heavy aggregate and steel furnace flux. All from Canada.

Table 10.—U.S. imports for consumption of unwrought titanium and waste and scrap

Country	1972		1973		1974	
	Quantity (short tons)	Value (thousands)	Quantity (short tons)	Value (thousands)	Quantity (short tons)	Value (thousands)
Austria	--	--	758	$404	1,299	$874
Belgium-Luxembourg	--	--	--	--	14	8
Canada	12	$9	120	116	142	194
France	10	10	17	20	79	149
Germany, West	141	147	311	492	247	556
Italy	(1)	1	11	9	--	--
Japan	2,345	4,255	2,960	5,508	2,797	6,510
Mexico	--	--	--	--	5	3
Netherlands	2	2	12	17	--	--
South Africa, Republic of	2	1	--	--	--	--
Sweden	--	--	--	--	244	211
U.S.S.R	1,408	2,109	1,628	2,504	4,032	7,410
United Kingdom	253	420	824	1,401	979	1,972
Total	4,173	6,954	6,641	10,471	9,838	17,887

[1] Less than ½ unit.

WORLD REVIEW

Australia.—Early in 1974, a Government spokesman, discussing policy in relation to mineral and energy resources, made the following points: (1) Contracts in foreign trade would henceforth be worded to eliminate the possibility of windfall gains or losses; (2) contracts would provide for long-term renegotiation of prices and for short-term escalation; (3) an increasing portion of mineral products presently exported would be domestically processed, and finished or semifinished items would be exported instead; and (4) overseas ownership of Australian mines would not be allowed to increase, and the Government would progressively reduce it as opportunities arise.

Trade sources indicated east coast production of 327,000 tons of rutile and west coast production of 768,000 tons of ilmenite and leucoxene.

Producers of rutile on Australia's east coast in 1974 were Associated Minerals Consolidated, Ltd.; Minsales (a subsidiary of Union Corp. Ltd. of South Africa), whose operating subsidiaries were Cudgen R.Z., and Consolidated Rutile, Ltd.; Rutile and Zircon Mines (Newcastle), Ltd.; Mineral Deposits, Ltd., and Queensland Titanium Mines Pty., Ltd. (both subsidiaries of NL Industries); and Dillingham Mining Co. of Australia. In 1974 this group of mines also produced 285,000 tons of zircon, 35,000 tons of ilmenite, and 1,000 tons of monazite.

Table 11.—Titanium: World production of concentrates (ilmenite, rutile, and titaniferous slag), by country

(Short tons)

Country [1]	1972	1973	1974 [p]
Ilmenite: [2]			
Australia [3]	[r] 791,616	792,651	909,395
Brazil [4]	[r] 4,179	4,599	[e] 4,600
Finland	164,795	175,267	[e] 168,000
India	[r] 100,387	85,088	[e] 85,000
Japan	2,331	[e] 2,400	[e] 2,400
Malaysia [5]	[r] 170,110	204,297	[e] 210,000
Norway	[r] 670,730	829,907	934,875
Portugal	829	672	[e] 550
Spain	[r] 24,783	4,108	--
Sri Lanka	90,944	103,046	89,395
United States [6]	[r] 681,694	[r] 776,013	744,572
Total	[r] 2,702,398	2,978,048	3,148,787
Rutile:			
Australia	[r] 345,176	358,914	355,478
Brazil [4]	454	46	[e] 210
India	3,379	3,748	[e] 3,800
Sri Lanka	2,371	2,482	3,363
United States	W	[r] 9,255	6,266
Total	[r] 351,380	[r] 374,445	369,117
Titaniferous slag:			
Canada [7]	[r] 920,416	942,704	931,170
Japan	3,668	4,690	4,855
Total	[r] 924,084	947,394	936,025

[e] Estimate. [p] Preliminary. [r] Revised. W Withheld to avoid disclosing individual company confidential data.

[1] In addition to the countries listed, the U.S.S.R. and the Republic of Korea also produce titanium concentrates, but available information is inadequate to make reliable estimates of output levels.

[2] Titaniferous slag production in Canada and Japan is reported separately. Ilmenite produced in Canada goes almost entirely into slag production; separate figures are not available.

[3] Includes leucoxene.

[4] Production of Comissão Nacional de Energia Nuclear only.

[5] Exports.

[6] Includes a mixed product containing ilmenite, leucoxene, and rutile.

[7] Contains 70% to 72% TiO_2.

In the Bunbury area of Western Australia, the largest producer of ilmenite was Western Titanium, a subsidiary of Consolidated Gold Fields, Ltd. Also producing were Western Mineral Sands, Pty., Ltd., Cable Sands Pty., and Westralian Sands, Ltd. In the Geraldton area, companies included Allied Eneabba Pty., Ltd., A. V. Jennings Mining Co., and Western Mining Corp., Ltd. (WMC), which took over the holdings of a number of corporate entities including West Coast Rutile, Ltd., Black Sands, Ltd., Kamilaroi Mines, Ltd., and Mining Corp. of Australia, Ltd. In addition to ilmenite, the mines in Western Australia produced 74,000 tons of zircon, 3,750 tons of rutile, and 2,500 tons of monazite in 1974.

On Fraser Island in Queensland, site preparation began early in 1974 for a sand operation jointly owned by Dillingham Mining Co. of Australia and Murphyores Holdings, Ltd. The deposit contains 2% heavy sands, and is expected to produce 65,000 tons per year of rutile and zircon, in about equal quantities, plus a small ilmenite byproduct. A wet mill will be built on the island, from which rough concentrates will be barged to a dry mill to be built at Maryborough. Environmental restoration will be conducted on a continuous basis. An initial investment of about $6 million is expected, with the operation to come on-line in mid-1975. Sand reserves were estimated to support 15 years of production.

Associated Minerals Consolidated, Ltd., was reportedly investigating processes for producing synthetic rutile from its growing stockpiles of otherwise unusable ilmenite.

In Western Australia, Allied Eneabba Pty., Ltd., encouraged by the results of 7 months of pilot-plant operation, began building its full-scale plant to produce 50,000 tons of rutile, 200,000 tons of ilmenite, and more than 100,000 tons of zircon annually, together with smaller quantities of other minerals. Rough concentrates will be moved to Geraldton for finishing. The plant was expected to cost $15 million, and to be in production by July 1975. The ilmenite will be exported to pigment plants of E. I. du Pont de Nemours & Co., Inc. in the United States; other products will be sold on the open market.

In the same area, the A. V. Jennings Mining Co. made its initial shipment of ilmenite from Geraldton to Japan. At full production, the output is expected to reach 240,000 tons per year of heavy minerals.

In December, WMC, Australia's leading nickel producer, exercised its option to buy the entire issued capital stock of Black Sands, Ltd., a company holding several mineral-sands deposits, including one at Jurien Bay. Black Sands was formerly owned two-thirds by Kamilaroi Mines, Ltd., and one-third by Mining Corp. of Australia Ltd. The price of the purchase was reportedly $11.5 million; heavy mineral reserves were about 3.5 million tons. Development at Jurien Bay was estimated to cost an additional $5 million. The firm plans to sell rutile and zircon, but to stockpile about 200,000 tons of ilmenite annually, probably with the intention of using it as a raw material for making synthetic rutile. The company has no immediate plans for the Black Sands, Ltd., deposits at Cooljarloo.

Laporte Industries (Holdings), Ltd., began a series of additions to its sulfate-process pigment plant at Bunbury, to add 50% to plant capacity by early 1976. Additional ilmenite supplies will be obtained from Western Titanium, N.L., which was reportedly considering the large-scale operation of a heretofore unworked deposit in addition to their present activity at Capel.

Westralian Sands, Ltd., jointly with Lennard Oil, Ltd., outlined a 2-million-ton body of sand near Gingin, and are planning commercial production.

France.—Thann et Mulhouse was building more capacity at its Le Havre sulfate-process pigment plant. Additions of 22,000 tons per year in 1975 and 13,000 in 1977 will bring total plant capacity to 100,000 tons annually.

Germany, West.—Kronos-Titan GmbH, a subsidiary of NL Industries, began a 22,000-ton-per-year capacity expansion of its sulfate-process pigment plant at Nordenham, now rated at a 44,000-ton annual capacity. The addition was scheduled for completion in 1976.

India.—The Indian Government was understood to have approved a proposal by Kerala Minerals & Metals, Ltd., at Quilon, to produce 48,000 tons of titanium pigment annually by the chloride process. The company also was formulating plans for a 100,000-ton-per-year synthetic rutile plant.

Italy.—In February, the sulfate-process pigment plant of Montecatini Edison, S.p.A., was permitted by authorities at the port of Livorno to resume ocean dumping of effluent from its Scarlino plant for a 6-month trial period. The company also continued construction of its 30,000-ton chloride-process plant at Crotone.

Japan.—Production of titanium sponge in 1974 was 9,825 tons. Power shortages hampered first-half production. An increasing portion of titanium was being domestically consumed, chiefly by the chemical-process industries.

Malaysia.—The Trengganu State Economic Development Corp. announced the formation of Syarikat Lombong Titanium Trengganu Sendrian Berhad, a joint venture with local industry, which began mining ilmenite in February at Bukit Payong. Annual production of 10,000 tons is expected.

Norway.—Kronos Titan A/S, an NL Industries subsidiary, announced a 25% capacity expansion at its 20,000-ton-per-year sulfate-process pigment plant at Fredrikstad. The additional facilities were scheduled for completion early in 1976.

Sierra Leone.—During the year, Bethlehem Steel Corp. increased its share of Sierra Rutile, Ltd., from 60% to 80%. Renewed production from this deposit, formerly controlled by Sherbro Minerals, Ltd., was scheduled for late 1975 or early 1976.

The Parliament of Sierra Leone ratified an agreement giving Bayer-Preussag Mining Co. a 5-year exclusive prospecting right in a 2,000-square-mile area along the southern coast. The company will conduct feasibility studies that will include operation of a pilot plant. Much of the rutile present is part of a lateritic formation, and freeing of the rutile grains is difficult.

South Africa, Republic of.—Quebec Iron and Titanium Corp. (QIT), Canada, was the successful bidder for the 49% share of the Richards Bay titaniferous sand deposit formerly held by King Resources, Ltd. The bid was $4 million. Later in the year, Union Corp. Ltd., a major African finance house, reportedly purchased a 25% share from QIT. The majority share is held by the Industrial Development Corp. of South Africa, Ltd., a Government corporation. Pilot-plant studies begun by King Resources are being continued. Plans for operating the deposit include smelting the ilmenite to make pig iron and Sorel slag, and selling the byproduct rutile and zircon on the open market. Production is expected late in 1977. Reserves are estimated at 41 million tons of ilmenite, 1.5 million tons of rutile, and 3.4 million tons of zircon.

Sri Lanka.—The Sri Lanka Geological Survey Department completed a reserve estimate of the black sand body at Pulmoddai, on the northeast coast. Exposed at mean low tide is a high-grade deposit of 3.26 million tons of heavy mineral, 4½ miles long, up to 300 feet wide, and 8 feet deep. Ilmenite accounts for 70% to 75% of this quantity; rutile, for 10% to 12%; zircon, for 8% to 10%; and monazite, for about 0.4%. The ilmenite is under long-term contract to Japanese interests. Technical difficulties at the China Bay dry plant limited the rutile and zircon output.

TECHNOLOGY

The geological genesis of the heavy-mineral deposits at Green Cove Springs and Boulogne, Fla., was described in a paper that indicated their association with an old beach line, now 25 to 30 miles inland because of regression of the sea.[4] Another paper presented a discussion of the advantages and disadvantages of bulk handling of titanium pigment, as both a dry powder and a slurry, paying particular attention to various means of transportation and storage, and their effect on costs.[5] As prices of pigment increased during the year, Johns-Manville offered pigment extenders based on either diatomite or talc, for use in paints and enamels; PPG Industries, Inc., discussed the similar use of amorphous silica in paint formulations.

A method for significantly reducing the quantity of titanium pigment used in paints was advanced by PPG.[6] Micronized air bubbles are blended uniformly throughout the paint, thereby achieving satisfactory whiteness and opacity.

Olin Corp. and Imperial Metal Industries, Ltd., were reportedly forming a joint company, Marstolin Electrolytic Systems, to market dimensionally stable titanium metal anodes and related titanium hardware for use in chloralkali cells.

Requirements that limit discharge of atmospheric pollutants from motor-vehicle systems in the United States has created a major demand for 409 steel, which contains 1% to 1.5% titanium. This demand in turn created increased demand for ferrotitanium in the United States and elsewhere in the world where vehicles are made for the U.S. market.

A meeting of representatives of major steel companies, several research institutes, and the Bureau of Mines was held in February to discuss substitutes for fluorspar in steelmaking. The basic conclusion was that no one substitute was satisfactory in all applications. However, titaniferous iron ore has been used in open-hearth and electric furnaces. This material does not have the desulfurizing power of metallurgical spar, but it is cheaper and has no pollution potential.

Bureau of Mines researchers published several reports related to titanium during the year.[7]

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[4] Pirkle, E. C., W. A. Pirkle, and W. H. Yoho. The Green Cove Springs and Boulogne Heavy-Mineral Sand Deposits of Florida. Econ. Geol., v. 69, 1974, pp. 1129–1137.

[5] Anderson, C. W. Bulk Handling of Titanium Pigments. Am. Paint J., v. 58, No. 39, Mar. 11, 1974, pp. 52–57.

[6] Chemical Marketing Reporter. Pigments. V. 205, No. 17, May 6, 1974, p. 23.

[7] Calvert, E. D., and R. R. Lowery. Room Temperature Tensile Properties of Titanium and Seven Titanium Alloys Prepared by Skull Casting. BuMines RI 7949, 1974, 26 pp.

Elger, G. W., D. E. Kirby, S. C. Rhoads, and W. A. Stickney. Synthesis of Rutile From Domestic Ilmenites. BuMines RI 7985, 1974, 19 pp.

Henry, J. L., S. D. Hill, W. E. Anable, and J. L. Schaller. Source and Control of Nitride Inclusions in Titanium. BuMines RI 7933, 1974, 48 pp.

Stuve, J. M. and M. J. Ferrante. Low-Temperature Heat Capacity and High-Temperature Enthalpy of $TiAl_3$. BuMines RI 7834, 1974, 9 pp.

Wood, F. W., P. A. Romans, R. A. McCune, and O. E. Paasche. Phases and Interdiffusion Between Titanium and its Mononitride. BuMines RI 7943, 1974, 40 pp.

Tungsten

By Richard F. Stevens, Jr. [1]

On a worldwide basis, tungsten concentrate was in short supply during most of 1974. This resulted in a significant increase in the price quoted by Metal Bulletin (London) to an alltime record high of $106 per short ton unit of tungsten trioxide (WO_3). The average 1974 price doubled over that reported in 1973. Inventories of tungsten concentrate around the world were reduced. Demand eased in the last quarter of the year as indicated by the decreased prices and reduced activity.

While domestic tungsten concentrate production decreased 3% to 7.4 million pounds in 1974, mine shipments rose 11% to 7.8 million pounds. Almost all of this material was obtained from the two continuously operating domestic tungsten mines, one in California and one in Colorado. Reported concentrate consumption increased 6% to 16.3 million pounds. Imports for consumption of tungsten concentrate rose 2% and totaled 11.1 million pounds, the highest level in 17 years. Production of ammonium paratungstate (APT) rose 13% to 14.7 million pounds during 1974 and reported consumption of APT increased 13% to 15.7 million pounds.

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[1] Physical scientist, Division of Ferrous Metals.

Table 1.—Salient tungsten statistics

(Thousand pounds of contained tungsten and thousand dollars)

	1970	1971	1972	1973	1974
United States:					
Concentrate:					
Production	9,625	6,900	8,150	7,575	7,381
Shipments	9,312	6,827	7,045	7,059	7,836
Value	$23,790	$20,184	$18,104	$19,154	$37,413
Consumption	16,700	11,622	14,107	15,386	16,298
Releases from Government stocks	15,066	1,381	3	1,498	6,071
Exports [1]	19,470	2,006	95	90	1,187
Imports, general	1,299	577	5,898	[r] 11,047	11,786
Imports for consumption	1,284	418	5,739	[r] 10,834	11,096
Stocks, Dec. 31:					
Producers	787	863	1,966	225	529
Consumers	1,467	2,657	2,229	1,446	1,565
Employment [2]	605	470	510	535	540
Ammonium paratungstate:					
Production	(3)	(3)	(3)	13,012	14,707
Consumption	(3)	(3)	(3)	13,945	15,733
Stocks, Dec. 31:					
Producers and consumers	(3)	(3)	(3)	945	1,062
Employment [e] [4]	NA	NA	NA	415	440
Primary products:					
Production	17,605	11,730	14,090	[r] 16,600	20,131
Consumption	15,352	11,159	13,296	17,984	20,556
Stocks, Dec. 31:					
Producers	4,569	3,722	4,680	3,523	3,628
Consumers	2,698	2,541	2,121	2,051	2,771
World: Concentrate:					
Production	71,360	78,055	[r] 84,952	84,150	82,357
Consumption	85,638	68,413	[r] 76,583	85,744	85,818

[e] Estimate. [r] Revised. NA Not available.

[1] Estimated tungsten content.

[2] Estimated number of persons at mines and mills, at yearend.

[3] Included with primary products.

[4] May include some personnel credited under "Concentrate: Employment."

During 1974 the reported price of shipped tungsten concentrate, f.o.b. mines and custom mills, increased 76% and averaged $75.73 per short ton unit; the quoted European price averaged $79.96 per short ton unit (about $83.93 per short ton unit with U.S. import tariff added).

Legislation and Government Programs.—During the year the General Services Administration (GSA) Office of Stockpile Disposal continued to sell excess stockpiled tungsten concentrate on the basis of monthly sealed bids. At the beginning of the year, GSA allocated 500,000 pounds of contained tungsten monthly for disposal. In April the maximum monthly disposal rate was increased to 650,000 pounds and was further increased to 850,000 pounds per month in May 1974. In early January 1975 the disposal rate was again reduced to 500,000 pounds per month. Under this program, nearly 6.1 million pounds of tungsten contained in concentrate was sold during 1974; 5,129,174 pounds for domestic use and 941,963 pounds for export. In addition 115,421 pounds of tungsten in ferrotungsten and 99,424 pounds of hydrogen reduced tungsten metal powder were sold from Government stockpiles. All of this material was for domestic consumption.

Table 2.—U.S. Government tungsten stockpile materials inventories and objectives

(Thousand pounds, tungsten content)

Material	Objective	Inventory by program Dec. 31, 1974			
		National (strategic) stockpile	DPA inventory	Supplemental stockpile	Total
Tungsten concentrate:					
Stockpile grade	4,234	69,440	4,265	3,304	77,009
Nonstockpile grade	--	37,051	509	1,153	38,713
Total inventory	--	106,491	4,774	4,457	115,722
Ferrotungsten	--	2,025	--	--	2,025
Tungsten metal powder, hydrogen reduced	--	1,048	--	--	1,048
Tungsten metal powder, carbon reduced	--	717	--	--	717
Tungsten carbide powder	--	953	--	1,080	2,033

A bill (H.R. 1257) to temporarily suspend the duty on tungsten concentrate and on other material in chief value of tungsten introduced in the First Session of the 93rd Congress died when no action was taken during the Second Session. An identical bill (H.R. 2826) was reintroduced early in the First Session of the 94th Congress.

DOMESTIC PRODUCTION

Domestic mine production of tungsten concentrate fell 3% and totaled 7.4 million pounds of contained tungsten during the year. Mine shipments increased 11% to 7.8 million pounds. Although 36 mines in 8 Western States reported production and 35 operations reported concentrate shipments, only 2 mines operated continuously throughout 1974: The Pine Creek mine and mill of the Mining and Metals Division, Union Carbide Corp. (UCC), located northwest of Bishop, Calif., in Inyo County; and the Climax mine and mill of Climax Molybdenum Co., a division of American Metal Climax, Inc. (AMAX), at Climax, Colo., in Lake County. The major mineral value recovered at Pine Creek continued to be tungsten with minor amounts of byproduct molybdenum, copper, gold and silver. UCC processed ore on a "straight through" basis to produce APT, an intermediate form of tungsten suitable for ready conversion to tungsten metal powder.

The major mineral value recovered at Climax was molybdenum. Concentrates of tungsten, tin, and pyrite recovered as coproducts are largely dependent upon the rate of molybdenum production. The maximum tungsten concentrate production capacity at Climax is about 2.5 million pounds of contained tungsten.

Intermittent tungsten concentrate production and/or shipments were also reported from Yuma County, Ariz.; Fresno, Kern, Inyo, Los Angeles, Madera, Mariposa, Mono, San Bernardino, San Diego, Tulare, and Tuolumne Counties, Calif.; Boulder County, Colo.; Valley County, Idaho; Deer Lodge and Granite Counties, Mont.; Churchill, Clark, Mineral, Nye, Pershing, and White Pine Counties, Nev.; Box Elder, Millard, and Tooele Counties, Utah; and Stevens County, Wash.

The Tungsten Queen mine and mill of Ranchers Exploration & Development Corp., near Townsville in Vance County, N. C., remained closed and on "standby" status throughout the year. Ranchers indicated that the facility would be reopened in mid-1975. When operating at capacity, the operation is designed to produce about 2 million pounds of contained tungsten annually from hubnerite ore having an average content of less than 0.5% WO_3. It is anticipated that minor amounts of lead, copper, silver, and pyrite will also be recovered.

In the latter part of 1974 UCC announced plans to develop a new tungsten mine and mill on the Tempiute property in Lincoln County, Nev., about 50 miles northwest of Alamo. The underground mine and adjoining surface mill was scheduled for completion and startup in the third quarter of 1976. When operating at designed capacity, the facility will produce about 2 million pounds of tungsten annually and byproduct zinc concentrate. The scheelite ore at Tempiute will be processed to tungsten concentrate prior to being shipped to UCC's Pine Creek (Calif.) facilities for processing to APT. When in full production, this operation is expected to employ about 90 to 100 workers with an annual payroll in excess of $2 million.

Late in the year, NL Industries, Inc., at Laredo, Tex., began operation of a tungsten concentrate recovery circuit adjacent to the company's Laredo antimony smelter. Low-grade semiconcentrate from Guatemala will be upgraded to synthetic scheelite. Depending on the grade of feed stock, capacity will be about 2,000 tons per year.

Table 3.—Tungsten concentrate shipped from mines in the United States

Year	Quantity			Reported value, f.o.b. mine [1]		
	Short tons 60% WO_3 basis [2]	Short ton units WO_3 [3]	Tungsten content (thousand pounds)	Total (thousands)	Average per unit of WO_3	Average per pound of tungsten
1970	9,785	587,088	9,312	$23,790	$40.52	$2.55
1971	7,173	430,427	6,827	20,184	46.89	2.96
1972	7,401	444,145	7,045	18,104	40.77	2.56
1973	7,418	445,051	7,059	19,154	43.04	2.71
1974	8,233	494,012	7,836	37,413	75.73	4.77

[1] Values apply to finished concentrate and are in some instances f.o.b. custom mill.
[2] A short ton of 60% tungsten trioxide (WO_3) contains 951.72 pounds of tungsten.
[3] A short ton unit equals 20 pounds of tungsten trioxide (WO_3) and contains 15.862 pounds of tungsten.

CONSUMPTION AND USES

The application of tungsten in cutting and wear-resistant materials, primarily as tungsten carbide, increased 22% and continued to represent the major form of tungsten product consumption. This use of tungsten carbide accounted for 60% and tungsten carbide in welding and hard-facing rods accounted for 8% of the total product consumption. In 1974 tungsten product consumption rose 14% to almost 20.6 million pounds of contained tungsten. Other major end-use categories during the year were specialty tool steels (14%) and mill products (13%).

During 1974 the consumption distribution of intermediate tungsten products used to make end-use items was as follows: Tungsten carbide (including cemented, crushed, and cast), 44%; tungsten metal powder (including carbon-and-hydrogen-reduced), 36%; and ferrotungsten and chemicals (including scheelite and scrap for direct addition to steel melts), 10% each.

Figure 2 is a simplified tungsten flow diagram showing the major processing steps, intermediate tungsten products, and major end use items.

Several special review articles were published during the year which evaluated the application of tungsten metal in high-temperature nuclear applications and evaluated tungsten carbide cutting tools.[3]

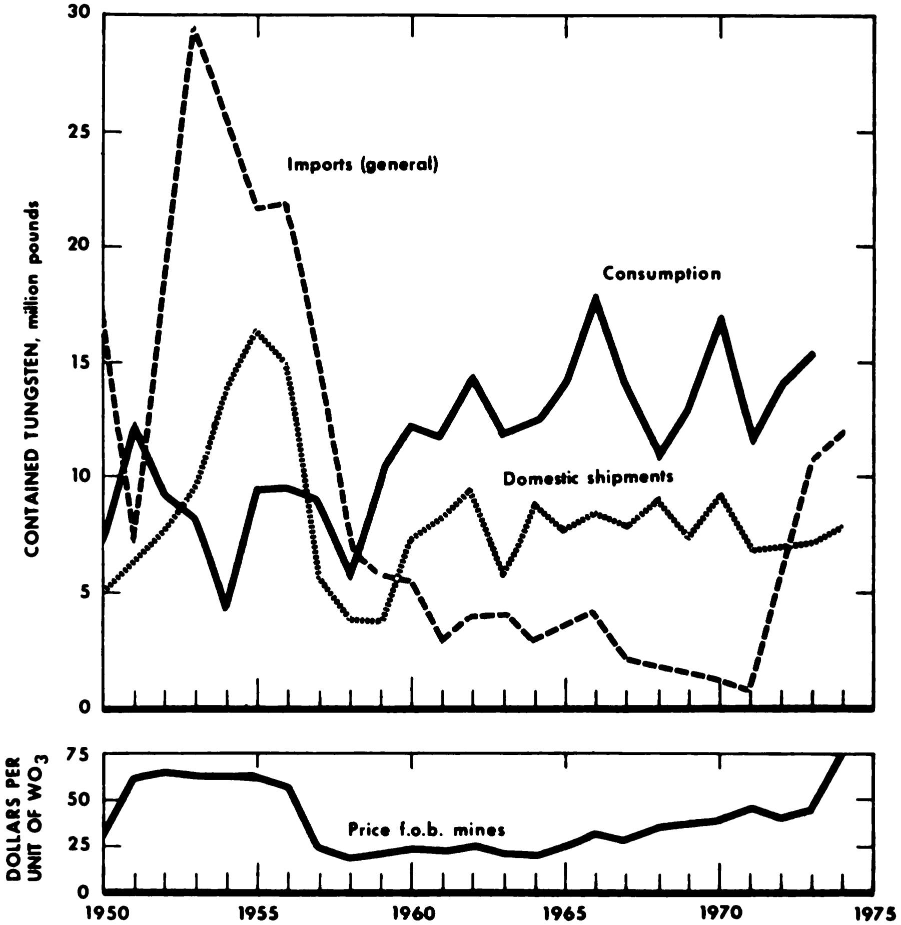

Figure 1.—Domestic shipments, imports, consumption and average price of tungsten ore and concentrate.

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[3] American Metal Market. Abrasives. V. 81, No. 243, Dec. 16, 1974, pp. 13–18.

———. Cutting Tools. V. 81. No. 58, Mar. 25, 1974, pp. 1A–8A.

———. Ferroalloys Section. V. 81, No. 100, Sec. 2, Mar. 22, 1974. pp. 1A–16A.

———. High-Temperature Alloys. V. 81, No. 129, Sec. 2, July 2, 1974, pp. 1A–16A.

———. Machining Centers. V. 81, No. 161, Sec. 2, Aug. 19, 1974, pp. 13–16.

———. Metal Traders Section. V. 81, No. 110, Sec. 2, June 6, 1974, pp. 1A–16A.

———. Non-Ferrous Scrap. V. 81, No. 50, Suppl.. Mar. 13, 1974, pp. 1A-32A.

———. Screw Machine Industry. V. 81, No. 224, Sec. 2, Nov. 18, 1974, pp. 1A–8A.

———. Space Age Metals. V. 81, No. 48, Mar. 11, 1974, pp 1A–12A and 25.

———. Specialty Steels. V. 81, No. 205, Sec. 2, Oct. 21, 1974, pp. 1A–8A.

———. Tungsten. V. 81, No. 77, Sec. 2, Apr. 19, 1974, pp. 1A–12A.

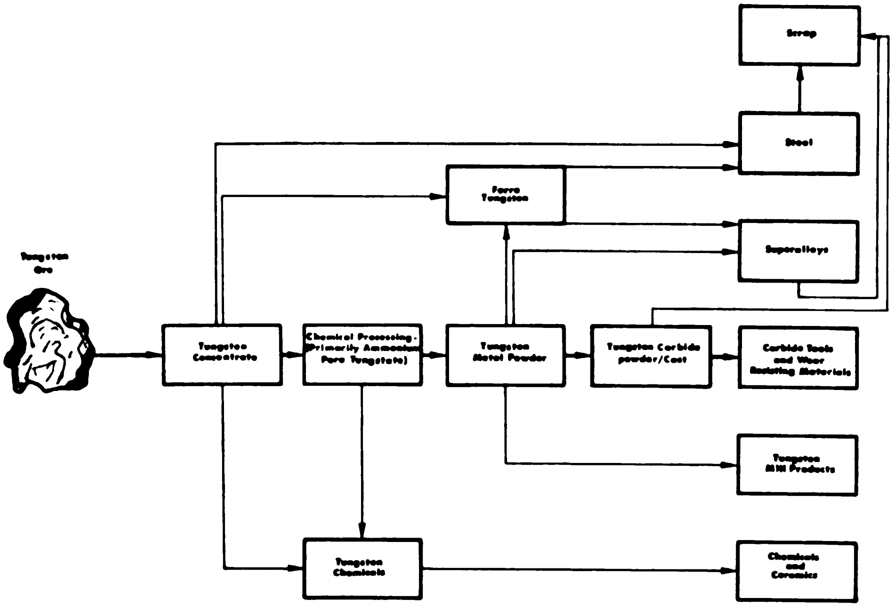

Figure 2.—Simplified tungsten flow diagram.

Table 4.—Production, disposition, and stocks of tungsten products in the United States

(Thousand pounds of contained tungsten)

	Hydrogen- and carbon-reduced metal powder	Tungsten carbide powder		Chemicals	Other [1]	Total [2]
		Made from metal powder	Crushed and crystalline			
1973: [r]						
Gross production during year	12,533	7,801	2,582	4,688	1,630	29,233
Used to make other products listed here	8,464	--	60	3,945	165	12,633
Net production	4,069	7,801	2,522	743	1,465	16,600
Disposition:						
To other processors	1,073	69	W	104	1,537	2,782
To end-use consumers	7,589	6,013	527	761	365	15,256
To make products not listed on this table	1,106	1,676	W	W	2,017	4,798
Producer stocks, Dec. 31	1,925	418	619	254	307	3,523
1974:						
Gross production during year	15,234	9,824	3,167	6,002	1,559	35,786
Used to make other products listed here	10,499	--	161	4,995	1	15,655
Net production	4,735	9,824	3,006	1,007	1,558	20,131
Disposition:						
To other processors	1,963	49	W	103	2,360	4,475
To end-use consumers	8,303	7,683	754	772	369	17,883
To make products not listed on this table	2,069	2,359	W	W	2,231	6,659
Producer stocks, Dec. 31	1,908	635	515	338	233	3,628

[r] Revised. W Withheld to avoid disclosing individual company confidential data; included in "Other."

[1] Includes ferrotungsten, scheelite (produced from scrap), nickel-tungsten, self-reducing oxide, pellets, and quantities indicated by symbol W.

[2] Data may not add to totals shown because of independent rounding.

Table 5.—Major producers of tungsten concentrate and principal tungsten processors in 1974

Company	Location of mine, mill or processing plant
Producers of tungsten concentrate:	
Climax Molybdenum Co., a subsidiary of AMAX	Climax, Colo.
Mines Exploration, Inc	Red Mountain, Calif.
Ranchers Exploration & Development Corp.[1]	Townsville, N.C.
Rawhide Mining Co	Fallon, Nev.
Union Carbide Corp., Mining & Metals Division[2]	Bishop, Calif.
Processors of tungsten:[3]	
Adamas Carbide Corp	Kenilworth, N.J.
Fansteel Inc	North Chicago, Ill.
General Electric Co	Cleveland and Euclid, Ohio, and Detroit, Mich.
GTE Sylvania, Inc., a subsidiary of General Telephone & Electronics Corp	Towanda, Pa.
Kennametal, Inc	Latrobe, Pa., and Fallon, Nev.
Li Tungsten Corp	Glen Cove, N.Y.
Molybdenum Corp. of America (Molycorp)	Washington and York, Pa.
Teledyne Firth Sterling	McKeesport, Pa.
Teledyne Wah Chang Huntsville	Huntsville, Ala.
Union Carbide Corp., Mining & Metals Division	Niagara Falls, N.Y.
Westinghouse Electric Corp	Bloomfield, N.J.

[1] On standby status, scheduled to reopen in 1975.
[2] At its Pine Creek mine and mill in California, UCC processes ore "straight through" to APT.
[3] Major consumers of tungsten concentrate and APT.

STOCKS

Reported stocks of tungsten concentrate held at domestic mines at yearend 1974 more than doubled and tungsten concentrate stocks held by consumers increased 8% during the year. Stocks of ammonium paratungstate rose 12% over that of 1973. Industry stocks of intermediate tungsten products continued to increase as indicated in tables 1, 4, and 6. Data on stocks of tungsten concentrate held by dealers were not available.

Table 6.—Consumption and stocks of tungsten products in the United States, by end use
(Thousand pounds of contained tungsten)

End use	Ferro-tungsten [1]	Tungsten metal powder [2]	Tungsten carbide powder	Other tungsten materials [3]	Total [4]
1973:					
Steel:					
Stainless and heat resisting	184	W	--	77	211
Alloy	128	W	--	225	353
Tool	1,474	W	--	541	2,015
Cast irons	W	--	--	6	6
Superalloys	152	136	W	318	606
Alloys (excludes steels and superalloys):					
Cutting and wear resistant materials	W	2,546	7,141	313	10,000
Other alloys [5]	71	756	340	118	1,285
Mill products made from metal powder	W	2,660	W	--	2,660
Chemical and ceramic uses	--	--	W	444	444
Miscellaneous and unspecified	5	125	273	1	404
Total	1,964	6,223	7,754	2,043	17,984
Consumer stocks Dec. 31	340	427	866	418	2,051
1974:					
Steel:					
Stainless and heat resisting	142	--	--	116	258
Alloy	245	W	--	396	641
Tool	1,402	--	--	642	2,045
Cast irons	1	--	--	--	1
Superalloys	128	138	W	341	607
Alloys (excludes steels and superalloys):					
Cutting and wear resistant materials	W	3,683	8,216	340	12,239
Other alloys [5]	94	946	480	138	1,658
Mill products made from metal powder	W	2,673	W	--	2,673
Chemical and ceramic uses	--	--	W	159	159
Miscellaneous and unspecified	4	14	256	1	275
Total [4]	2,016	7,454	8,952	2,134	20,556
Consumer stocks Dec. 31	491	622	1,078	580	2,771

W Withheld to avoid disclosing individual company confidential data, included in "Miscellaneous and unspecified."

[1] Includes melting base self-reducing tungsten.

[2] Includes both carbon-reduced and hydrogen-reduced tungsten metal powder.

[3] Includes tungsten chemicals, natural and synthetic scheelite, tungsten scrap and other.

[4] Data may not add to totals shown because of independent rounding.

[5] Includes welding and hard-facing rods and materials and nonferrous alloys.

PRICES AND SPECIFICATIONS

During 1974, the average value of tungsten concentrate shipped from domestic mines and mills as reported to the Bureau of Mines increased 76% to $75.73 per short ton unit of WO_3. Tungsten concentrate for domestic use was purchased from GSA during the year at prices, ex-duty, ranging from $42.10 to $106.28 per short ton unit. For export, the price ranged from $47.75 to $91.88 per short ton unit.

As quoted in the Metal Bulletin (London) and reported in Metals Week the European price of tungsten concentrate, shown in table 7, increased throughout the year from a low in January of £21.00 per metric ton unit (about $41.53 per short ton unit depending upon the prevailing rate of currency exchange) to a high of £50.25 per metric ton unit (about $105.90 per short ton unit) in September.

The price of APT delivered to large volume contract customers was $62.50 per short ton unit at the beginning of 1974. This price was increased to $72.50 per short ton unit in May, to $97.50 per short ton unit in July, and to $116.50 per short ton unit in September. The price of "Blue Oxide" was set at $2 per short ton unit above the APT price plus 1% surcharge to provide for processing losses.

In January a conversion fee of about $11 per short ton unit was charged for "toll" processing tungsten concentrate to APT at a recovery rate of about 96%. At midyear the tolling charge was increased to $14.50 per short ton unit and by yearend 1974 increased to $17 per short ton unit.

The quoted price of carbon-reduced tungsten metal powder, as reported in Metals Week, f.o.b. shipping point, was $4.50 per pound of contained tungsten in 1,000-pound lots in January. During the year the quotations on carbon-reduced tungsten metal powder were discontinued as activity in this material ceased. The price of hydrogen-reduced tungsten metal powder (99.99% purity), f.o.b. shipping point, as quoted in Metals Week, rose from a range of $4.97 to $6.74 per pound of contained tungsten at the beginning of the year to a range of $9.64 to $11.34 per pound at yearend. Within these ranges, the price was primarily dependent upon the tungsten powder particle size (Fisher number).

The price quotations of low-molybdenum-containing ferrotungsten was discontinued during the year. The U.S. dealer price of ferrotungsten for export during 1974, as quoted in Metals Week rose from $4.50 per pound of tungsten in January to $6.00 to $7.00 per pound in December. The quoted price of UCAR, a proprietary high-purity ferrotungsten produced by Union Carbide Corp., 90% tungsten, doubled from $3.98 to $8.20 per pound of contained tungsten during the year.

The price of scheelite concentrate (calcium tungstate) for direct addition to steel melts was believed to be comparable with data reported in table 7.

Table 7.—Monthly price quotations of tungsten concentrate in 1974

Month	Wolfram and scheelite: London market, pounds sterling per metric ton unit of WO_3, 65% basis		Equivalent quotations, dollars per short ton unit of WO_3, 65% basis[1]		
	Low	High	Low	High	Average[2]
January	£21.00	£22.70	$41.58	$ 46.13	$ 43.93
February	21.40	23.65	44.35	49.24	46.73
March	23.00	25.80	48.02	55.24	51.68
April	25.50	34.00	55.57	74.12	60.96
May	36.00	47.50	79.00	103.92	92.82
June	41.00	45.50	88.75	98.78	92.85
July	41.00	43.50	88.62	94.63	91.84
August	43.00	43.00	92.96	100.72	96.43
September	47.00	50.25	98.77	105.90	101.73
October	47.00	50.00	99.41	106.09	103.14
November	42.00	47.00	88.15	99.58	92.95
December	37.50	43.00	79.33	90.68	84.45

[1] Equivalent high and low quotations as reported in Metals Week from Metal Bulletin (London) data; price dependent upon the prevailing rate of exchange.

[2] Arithmetic average of weekly quotations. The equivalent 1974 average price $79.96 per short ton unit; duty $3.97; equivalent average price, duty paid, $83.93 per short ton unit.

FOREIGN TRADE

Exports.—Tungsten concentrate exports during 1974 increased by a factor of 13 and represented excess material purchased from GSA stockpiles. Ferrotungsten exports rose 52% while exports of APT decreased 79%. Exports of tungsten carbide powder, primarily to Canada and Mexico (26% each), and the Netherlands (18%), almost doubled during 1974.

In 1974 exports of unwrought tungsten metal and alloys in crude form, waste, and scrap increased 5% to 709,461 pounds, gross weight, valued at $1,343,674. This material was shipped primarily to West Germany (70%) and to the United Kingdom and the Netherlands (8% each). Tungsten and tungsten alloy powder exports increased by a factor of three during the year to 1,388,643 pounds, gross weight, valued at $8,468,182. This material was exported primarily to Israel (36%), Japan (18%), Canada (10%), the United Kingdom (9%), and the Netherlands (8%).

Exports of tungsten and tungsten alloy wire increased 20% to 270,525 pounds, gross weight, valued at $7,129,629 in 1974 and were shipped primarily to Canada (21%), Japan (20%), the United Kingdom (9%), and Brazil (8%). Wrought tungsten and tungsten alloy exports rose 86% during the year to 288,750 pounds, gross weight, valued at $3,623,183. Most of these exports were shipped to West Germany (47%), Canada (19%), and Japan (9%).

Table 8.—U.S. exports of tungsten ore and concentrates, by country
(Thousand pounds and thousand dollars)

Country	1973			1974		
	Gross weight	Tungsten content[1]	Value	Gross weight	Tungsten content[1]	Value
Canada	--	--	--	10	5	28
France	--	--	--	110	57	199
Germany:						
East	--	--	--	275	142	338
West	--	--	--	1,258	649	2,468
Japan	--	--	--	65	33	92
Netherlands	146	75	204	392	203	1,237
Sweden	--	--	--	55	28	111
United Kingdom	28	15	35	136	70	362
Total	174	90	239	2,301	1,187	4,835

[1] Tungsten content estimated by multiplying the gross weight by a factor of 0.516 equal to 0.65 (to convert from 65% to 100% WO_3 basis) times 0.7931 (to convert from WO_3 to W basis).

Table 9.—U.S. exports of ferrotungsten, by country

Country	1973			1974		
	Gross weight (pounds)	Estimated[1] tungsten content (pounds)	Value	Gross weight (pounds)	Estimated[1] tungsten content (pounds)	Value
Canada	9,574	7,659	$38,298	8,327	6,661	$34,952
India	--	--	--	500	400	2,948
Mexico	3,200	2,560	12,175	10,572	8,458	177,061
Total	12,774	10,219	50,473	19,399	15,519	214,961

[1] Estimated tungsten content obtained by multiplying gross weight by 0.80.

Table 10.—U.S. exports of ammonium paratungstate, by country

Country	1973			1974		
	Gross weight (pounds)	Estimated tungsten content[1] (pounds)	Value	Gross weight (pounds)	Estimated tungsten content[1] (pounds)	Value
Australia	--	--	--	1,000	707	$18,950
Canada	21,000	14,839	$60,480	--	--	--
El Salvador	--	--	--	308	218	1,123
Ethiopia	388	274	775	--	--	--
Germany, West	88,026	62,199	174,183	47,097	33,279	163,470
Japan	304,981	215,500	539,034	33,563	23,716	42,952
Mexico	--	--	--	2,031	1,435	8,125
Netherlands	--	--	--	2,100	1,484	7,665
Peru	890	629	1,780	--	--	--
Philippines	84	59	518	248	175	1,686
South Africa, Republic of	400	283	628	--	--	--
Zaire	--	--	--	73	50	1,244
Total	415,769	293,783	777,898	86,420	61,064	245,215

[1] Estimated contained weight obtained by multiplying gross weight by 0.7066.

Table 11.—U.S. exports of tungsten carbide powder

Country	1973			1974		
	Gross weight (pounds)	Estimated tungsten content[1] (pounds)	Value	Gross weight (pounds)	Estimated tungsten content[1] (pounds)	Value
Angola	--	--	--	1,450	1,131	$6,525
Argentina	30	23	$628	7,252	5,656	37,997
Australia	5,382	4,198	41,882	26,385	20,580	201,013
Austria	64,557	50,355	451,074	40,756	31,790	304,953
Belgium-Luxembourg	18,448	14,390	127,657	21,826	17,024	186,195
Brazil	6,784	5,292	49,227	15,255	11,899	75,722
Canada	734,578	572,971	1,099,451	771,616	601,860	2,214,896
Chile	2,435	1,899	16,200	2,919	2,277	17,850
Costa Rica	471	367	4,799	2,592	2,022	16,238
Denmark	2,535	1,977	11,561	3,901	3,043	27,287
Finland	230	179	739	--	--	--
France	32,920	25,678	170,511	7,639	5,958	69,380
Germany, West	118,332	92,299	789,711	126,252	98,477	926,586
Indonesia	--	--	--	5,000	3,900	568
Iran	--	--	--	36,797	28,702	55,275
Ireland	14,453	11,273	62,754	7,430	5,795	76,508
Israel	53,589	41,800	262,956	83,869	65,418	516,840
Italy	42,559	33,196	340,088	59,043	46,054	598,970
Japan	52,864	41,234	328,629	241,883	188,669	1,805,176
Malaysia	17	13	3,206	--	--	--
Mexico	131,807	102,810	633,648	758,204	591,399	742,770
Netherlands	28,842	22,497	202,389	516,253	402,677	342,250
New Zealand	80	62	1,608	--	--	--
Nigeria	--	--	--	1,200	936	8,856
Norway	75	59	929	--	--	--
Oman	--	--	--	2,000	1,560	1,350
Peru	--	--	--	14,460	11,279	24,480
Poland	44	34	605	--	--	--
Portugal	360	281	3,596	80	62	858
Qatar	--	--	--	2,500	1,950	5,000
Romania	126,903	98,984	608,319	--	--	--
Singapore	--	--	--	688	537	7,216
South Africa, Republic of	17,441	13,604	77,777	10,917	8,515	91,860
Spain	4,316	3,366	32,166	25,837	20,153	196,358
Sweden	3,560	2,777	18,564	335	261	4,351
Switzerland	14,121	11,014	83,256	37,784	29,472	308,237
Taiwan	400	312	2,800	486	379	5,146
Thailand	--	--	--	3,711	2,894	2,121
Trinidad and Tobago	200	156	1,228	--	--	--
United Kingdom	33,627	26,229	185,211	93,347	72,811	547,301
Venezuela	305	238	1,446	6,533	5,096	12,557
Yemen	--	--	--	4,102	3,200	736
Total	1,512,265	1,179,567	5,614,615	2,940,302	2,293,436	9,439,426

[1] Estimated tungsten content obtained by multiplying gross weight by 0.78.

Table 12.—U.S. exports of tungsten alloy powder

Country	1973			1974		
	Gross weight (pounds)	Estimated tungsten content[1] (pounds)	Value	Gross weight (pounds)	Estimated tungsten content[1] (pounds)	Value
Argentina	--	--	--	53	42	$1,371
Australia	5,078	4,062	$25,321	12,582	10,066	80,254
Austria	18,591	14,873	83,025	35,411	28,329	231,996
Belgium-Luxembourg	36,316	29,053	164,025	27,514	22,011	146,968
Brazil	9,042	7,234	43,657	1,272	1,018	10,281
Canada	128,495	102,796	713,162	135,690	108,552	806,807
Finland	7,711	6,169	36,161	22,044	17,635	114,681
France	430	344	3,955	3,061	2,449	29,100
Germany, West	58,503	46,802	312,960	53,105	42,484	361,092
India	895	716	4,247	2,075	1,660	10,028
Ireland	1,175	940	10,175	400	320	2,380
Israel	30,259	24,207	142,333	506,512	405,210	3,399,746
Italy	2,304	1,843	10,895	2,784	2,227	31,846
Japan	137,779	110,223	646,315	253,118	202,494	1,482,569
Mexico	11,855	9,484	61,502	7,575	6,060	40,649
Netherlands	--	--	--	110,000	88,000	375,800
Peru	--	--	--	158	126	1,750
Singapore	--	--	--	76,836	61,469	479,938
Spain	208	166	2,550	110	88	1,298
Sweden	4,537	3,630	23,082	--	--	--
Switzerland	2,121	1,697	19,029	15,896	12,717	96,188
Taiwan	300	240	3,600	283	226	4,650
United Kingdom	2,034	1,627	10,941	120,789	96,631	742,622
Venezuela	--	--	--	1,375	1,100	16,168
Total	**457,633**	**366,106**	**2,316,935**	**1,388,643**	**1,110,914**	**8,468,182**

[1] Estimated tungsten content obtained by multiplying gross weight by 0.80.

Imports.—Imports for consumption of tungsten concentrate rose 2% during 1974 and totaled almost 11.1 million pounds of contained tungsten, the highest import level since 1957. The major sources of these imports were Bolivia (19%), Portugal and Canada (15% each), Thailand, (14%), and Peru (12%).

Imports of tungsten carbide during the year, primarily from West Germany (65%) and Sweden (34%), decreased 21% and totaled 165,238 pounds of contained tungsten valued at $1,580,411. Imports of waste and scrap containing over 50% tungsten increased by a factor of two and totaled 168,720 pounds of tungsten valued at $693,827. This material was received principally from West Germany (26%), Israel (24%), the Netherlands (18%), and Sweden (13%). Imports of unwrought tungsten (except alloys) in lump, grain, and powder fell 53% to 26,302 pounds of contained tungsten valued at $239,004 and were received mainly from West Germany (64%). Wrought tungsten imports in 1974 increased 47% and totaled 24,588 pounds valued at $1,189,308. This material was imported principally from Austria (75%) and Japan (18%).

Imports of tungsten material classified as "metal-bearing materials in chief value of tungsten" decreased 33% and totaled 201,074 pounds of contained tungsten valued at $715,247. These imports were received from the Republic of Korea (84%) and Thailand (16%). Most of the material imported under this classification was believed to be synthetic scheelite. In addition, 1,062,372 pounds of contained tungsten was imported, all from the Republic of Korea, as ammonium tungstate valued at $4,183,365.

In 1974 calcium tungstate imports, all from West Germany, fell 20% and totaled 30,749 pounds of contained tungsten valued at $394,500.

Table 13.—U.S. imports[1] of tungsten ore and concentrates, by country
(Thousand pounds and thousand dollars)

Country	1973			1974		
	Gross weight	Tungsten content	Value	Gross weight	Tungsten content	Value
Argentina	111	59	61	62	30	116
Australia	551	320	748	161	87	279
Belgium-Luxembourg	--	--	--	33	18	28
Bolivia	3,910	2,183	4,659	4,259	2,381	8,683
Brazil	^{r}761	433	932	523	297	1,173
Burma	56	31	54	392	205	563
Canada	^{r}5,530	^{r}3,311	^{r}7,860	3,202	1,648	6,494
Chile	132	74	131	--	--	--
China, People's Republic of	^{r}209	^{r}110	^{r}288	584	311	1,174
France	^{r}255	^{r}81	^{r}163	464	136	432
Germany, West	^{r}784	^{r}285	^{r}371	226	71	146
Guatemala	2,282	371	46	882	154	21
Japan	--	--	--	81	46	258
Korea, Republic of	964	^{r}548	1,145	741	419	1,778
Malaysia	568	323	685	298	170	372
Mexico	614	333	727	649	336	1,475
Netherlands	--	--	--	58	30	74
Peru	1,742	1,039	2,064	2,322	1,309	5,075
Portugal	303	176	470	2,779	1,635	6.940
Rwanda	202	108	238	863	462	1,058
South Africa, Republic of	^{r}264	^{r}123	^{r}300	224	114	352
Spain	^{r}142	^{r}79	^{r}201	176	95	298
Sweden	--	--	--	66	36	78
Thailand	^{r}1,614	^{r}866	^{r}1,869	3,234	1,655	5,732
Uganda	22	11	32	--	--	--
United Kingdom	--	--	--	94	53	257
Zaire	338	183	417	168	88	212
Total	^{r}21,304	^{r}11,047	^{r}23,461	22,541	11,786	43,068

^{r} Revised.

[1] Data are "general imports," that is, they include tungsten imported for immediate consumption plus material entering warehouses.

Table 14.—U.S. imports for consumption of tungsten ore and concentrates, by country
(Thousand pounds and thousand dollars)

Country	1973			1974		
	Gross weight	Tungsten content	Value	Gross weight	Tungsten content	Value
Argentina	111	59	61	38	19	70
Australia	551	320	748	161	87	279
Belgium-Luxembourg	--	--	--	33	18	28
Bolivia	3,912	2,183	4,659	3,749	2,065	7,389
Brazil	815	465	989	468	266	1,094
Burma	56	31	55	392	205	563
Canada	^{r}5,530	^{r}3,311	^{r}7,860	3,177	1,633	6,400
Chile	132	74	131	--	--	--
China, People's Republic of	^{r}209	^{r}110	^{r}288	584	311	1,174
France	^{r}255	^{r}81	^{r}163	464	136	432
Germany, West	^{r}784	^{r}285	^{r}371	226	71	146
Korea, Republic of	964	^{r}548	1,145	644	364	1,478
Malaysia	568	323	685	298	170	372
Mexico	646	348	745	649	336	1,475
Netherlands	--	--	--	58	30	74
Peru	1,742	1,039	2,064	2,440	1,375	5,413
Portugal	303	176	470	2.779	1,635	6,940
Rwanda	202	108	238	863	462	1,058
South Africa, Republic of	^{r}264	^{r}123	^{r}300	224	114	352
Spain	^{r}142	^{r}79	^{r}201	176	95	298
Sweden	--	--	--	66	36	78
Thailand	^{r}1,822	^{r}977	^{r}2,104	2,991	1,527	5,114
Uganda	22	11	32	--	--	--
United Kingdom	--	--	--	94	53	257
Zaire	338	183	416	168	88	212
Total	^{r}19,368	^{r}10,834	^{r}23,725	20,742	11,096	40,696

^{r} Revised.

Table 15.—U.S. imports for consumption of ferrotungsten, by country

Country	1973			1974		
	Gross weight (pounds)	Estimated tungsten content (pounds)	Value	Gross weight (pounds)	Estimated tungsten content (pounds)	Value
Austria	405,982	333,166	$979,121	288,258	235,358	$938,373
Belgium-Luxembourg	11,023	9,310	25,352	--	--	--
Brazil	--	--	--	50,706	35,606	103,202
Canada	53,845	41,848	115,594	64,955	51,223	204,921
France	33,069	25,906	73,087	143,299	111,371	415,003
Germany, West	197,891	157,367	406,522	--	--	--
Portugal	94,357	78,894	209,978	77,161	63,856	219,466
Sweden	--	--	--	54,625	38,965	116,024
United Kingdom	596,181	460,016	1,295,154	330,061	271,544	1,032,217
Total	1,392,298	1,106,507	3,104,808	1,009,065	807,923	3,029,206

Table 16.—U.S. imports for consumption of tungsten and tungsten carbide forms

(Thousand pounds and thousand dollars)

Year	Ingots, shot, bars, and scrap		Wire, sheets, and other forms, n.s.p.f.		Total	
	Quantity	Value	Quantity	Value	Quantity	Value
1972	467	1,232	624	2,309	1,091	3,541
1973	730	1,431	703	3,516	1,433	4,947
1974	680	1,823	1,782	7,545	2,462	9,368

WORLD REVIEW

During 1974 two international meetings on tungsten were held in Geneva, Switzerland, to discuss methods of stabilizing world prices and to evaluate statistical data on tungsten concentrate trade and product consumption. The Working Group of the United Nations Conference on Trade and Development's (UNCTAD) Committee on Tungsten met in August to consider a paper developed by the UNCTAD Secretariat regarding the feasibility of establishing an International Tungsten Council, similar to the International Tin Council, and/or establishing a system of minimum and maximum prices for tungsten concentrate. The UNCTAD Committee on Tungsten subsequently met in November. The Committee staff continued to canvass, tabulate, and report detailed statistics on tungsten concentrate production, consumption, and world trade and on intermediate tungsten product consumption in its quarterly bulletin "Tungsten Statistics." [3]

In addition, a meeting of many of the world tungsten-producing companies was held in Lisbon, Portugal, in order to prepare a unified "producers program" for presentation at the November UNCTAD meeting. A subsequent meeting was scheduled to be held in La Paz, Bolivia, in April 1975.

Many tungsten-consuming companies of the world, particularly from Western Europe, met in Coventry, England, during June to develop a tungsten price index which would be published in the Metal Bulletin (London).

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[3] UNCTAD Committee on Tungsten (Geneva, Switzerland). Tungsten Statistics. V. 8, Nos. 1-4, 1974.

Table 17.—Tungsten: World concentrate production by country

(Thousand pounds of contained tungsten) [1]

Country	1972	1973	1974 [p]
North America:			
Canada [2]	3,527	3,680	2,811
Guatemala	18	348	[e] 350
Mexico	798	767	681
United States	8,150	7,575	7,881
South America:			
Argentina	[r] 348	183	[e] 200
Bolivia [3]	[r] 4,954	4,264	4,471
Brazil [4]	2,515	2,194	[e] 2,200
Peru	[r] 2,103	1,896	[e] 1,900
Europe:			
Czechoslovakia [e]	165	175	175
France	[r] 1,248	1,548	[e] 1,350
Portugal	3,093	3,336	3,280
Spain	798	690	661
Sweden	[e] 90	478	[e] 500
U.S.S.R. [e]	15,900	16,300	16,300
United Kingdom	4	--	--
Africa:			
Nigeria	[e] 2	3	[e] 3
Rhodesia, Southern [5]	333	339	201
Rwanda	[r] 525	[e] 570	[e] 570
South Africa, Republic of	1	1	--
South-West Africa, Territory of [6]	196	49	--
Tanzania	6	2	1
Uganda	240	[e] 240	[e] 240
Zaire	[r] 633	532	420
Asia:			
Burma	[r] 1,213	1,133	[e] 750
China, People's Republic of [e]	16,500	17,600	18,700
India	37	24	27
Japan	[r] 1,980	2,072	1,786
Korea, North [e]	4,740	4,750	4,750
Korea, Republic of	3,966	4,504	5,132
Malaysia	12	297	[e] 300
Thailand	7,370	5,736	4,308
Oceania:			
Australia	[r] 3,470	2,862	[e] 2,400
New Zealand	17	2	9
Total	[r] 84,952	84,150	82,357

[e] Estimate. [p] Preliminary. [r] Revised.

[1] Conversion factors: WO_3 to W, multiply by 0.7931; 60% WO_3 to W, multiply by 0.4758.

[2] Producer's shipments; actual production data is not officially reported, but available company figures indicate a substantial difference between actual output and shipments in some years.

[3] Data presented are the sum of production reported by COMIBOL and exports credited to medium and small mines.

[4] Figures exceed those reported in official Brazilian sources; these sources do not include production by small mines, which in aggregate apparently are substantial.

[5] Production from Beardmore mine only, and are for the year ended September 30 of that stated.

[6] Data are for South West Africa Co. Ltd. only, and are for the year ended June 30 of that stated.

Table 18.—Tungsten: World concentrate consumption, by country

(Thousand pounds of contained tungsten)

Country[1]	1972	1973	1974[p]
Actual consumption:			
Australia	88	88	[e] 88
Austria	3,109	2,469	2,310
Czechoslovakia[e]	3,000	[r] 3,000	2,900
France	2,734	3,854	[e] 4,076
Japan	5,128	7,950	[e] 6,665
Portugal	679	703	831
Sweden	3,040	3,228	[e] 3,790
United Kingdom	7,205	[e] 7,937	[e] 8,157
United States	14,107	15,386	16,298
Apparent consumption, excluding stock variations:[2]			
Argentina	97	115	[e] 110
Belgium-Luxembourg	108	346	[e] 362
Brazil	[e] 494	562	[e] 520
Bulgaria[e, 3]	70	65	65
Canada[e]	551	[r] 525	500
China, People's Republic of[e, 3]	4,500	4,500	4,500
Germany:			
East[e, 3]	700	[r] 650	600
West	5,514	6,931	[e] 5,295
Hungary[3]	50	50	50
India	423	333	[e] 386
Italy	104	198	[e] 165
Korea, North[e, 3]	3,500	3,500	3,500
Korea, Republic of[e, 4]	--	550	1,400
Netherlands	1,581	1,971	3,818
Poland	3,993	5,148	3,730
Romania[e, 3]	30	30	30
South Africa, Republic of	794	[e] 573	[e] 496
Spain	284	[e] 287	[e] 276
U.S.S.R.[e, 3]	14,700	14,800	14,900
Total	76,583	85,744	85,818

[e] Estimate. [p] Preliminary. [r] Revised.

[1] In addition, the following countries may consume tungsten concentrate, but specific data are not available: Denmark, Finland, Israel, Norway, Switzerland, and Yugoslavia.

[2] Production plus imports minus exports.

[3] Estimated by author.

[4] Data represents tungsten concentrate consumed to make ammonium paratungstate at APT plant adjacent to Sangdong mine.

Primary source: UNCTAD Committee on Tungsten quarterly reports "Tungsten Statistics" and Annual Company Reports.

Table 19.—Tungsten: Estimated world reserves and resources by major country

(Million pounds of contained tungsten)

Country	Reserves	Resources
North America:		
Canada	476	700
Mexico	2	5
United States	238	720
South America:		
Bolivia	87	185
Brazil	40	95
Europe:		
Portugal	22	65
U.S.S.R.[e]	350	700
Africa:		
Rhodesia, Southern	10	10
Rwanda	5	5
South-West Africa, Territory of	3	5
Zaire, Republic of	3	5
Asia:		
Burma	70	155
China, People's Republic of[e]	2,100	4,000
Japan	5	10
Malaysia	32	75
Korea, North[e]	250	300
Korea, Republic of	101	175
Thailand	40	85
Oceania: Australia	76	210
Other	12	30
Total[1]	3,920	7,490

[e] Estimate.

[1] Data may not add to totals shown due to independent rounding.

Argentina.—A plant was being installed in San Luis Province which, when operational, will have a capacity to process about 510 short tons of tungsten per year.

Australia.—Tungsten concentrate production, almost entirely from King Island Scheelite, Ltd., a subsidiary of Peko-Wallsend Ltd., decreased in quantity but increased in value during the year.[4] During 1974 the trading activities of Warman Equipment (International) Ltd., were absorbed into the tungsten activities of King Island Scheelite, Ltd., and the latter company was renamed Warman International Ltd.

Austria.—Preparatory work on the first major tungsten mine in Central Europe was scheduled to begin in mid-1975 near Mittersill, Salzburg.[5] A joint venture of Metallgesellschaft A.G., Frankfurt Am Main, and Vereinigte Österreichische Eisen und Stahlwerke A.G., (Voest-Alpine) Linz-Donau, (47.5% each), and Teledyne, Inc. (parent of Teledyne Wah Chang), United States, (5%) it is expected to produce about 1,000 to 1,500 short tons of tungsten annually. Presently proven recoverable reserves will support operation of the adjacent ore-dressing plant for 15 to 20 years. During the first 5 years of its operation the mine will recover tungsten ore by open pit mining methods; in subsequent years, underground mining will be employed. The low-molybdenum-containing scheelite ore assays about 0.7% WO_3 which will be processed at the mine/mill site by hydrometallurgical methods to tungsten semiconcentrate (20% to 30% WO_3). This material will be shipped to a processing plant at Bergla, Styria, in southwestern Austria where Voest-Alpine plans to recover tungsten products by solvent extraction techniques. When the refinery comes onstream in late 1976, the products will be APT, tungsten metal powder, and tungsten carbide powder. Output will reportedly equal about 10% of the present European demand. About 75% of the products will be exported with the remaining 25% consumed domestically.

A comprehensive evaluation of the present status of powder metallurgy in Austria was released during the year.[6] Based upon sales, tungsten and other refractory metals form the largest segment of powder metallurgy production in Austria. Production and processing is conducted by Metallwerk Plansee, at Reutte in the Tyrol. About 95% of production is for export.

The combined carbide production of the three major Austrian firms, Metallwerk Plansee, Schoeller-Bleckmann Stahlwerke A.G. and Gebruder Böhler & Co. A.B., ranges from 165 to 225 short tons of cemented carbide annually.

Brazil.—An analysis of the current powder metallurgy in Brazil and its future prospects was released.[7] Cemented tungsten carbides produced by powder metallurgy methods for machining applications was estimated to total 0.2 million pounds in 1973. By 1980 the annual production/demand of tungsten carbide in Brazil is expected to increase to about 0.3 to 0.4 million pounds.

Scheelite tungsten ore mined and chemically treated to WO_3 concentrate in Brazil represents the major raw material for tungsten carbide production.

Studies are being conducted in Brazil to adapt foreign tungsten carbide grades to local conditions. The most important Brazilian powder metallurgy companies are located in the State of São Paulo.

Burma.—Rehabilitation of the Mawchi tin-tungsten mines, which was begun in 1969 under a cooperative aid agreement with the U.S.S.R., was expected to be completed by the end of 1974.[8] Soviet technicians and aid are no longer involved in the Mawchi development project. When completed in early 1975, the present annual production of 875 short tons of mixed tin-scheelite concentrates will be increased to 2,000 tons per year.

Expansion of the Heinda tin-tungsten mine in Southern Burma was scheduled for completion in 1975 at which time the current production of 550 short tons of tin and tungsten concentrates is expected to double.

Rehabilitation of the Hermyingyi tin-tungsten mine in Southern Burma will introduce modern mining methods. Upon completion in late 1975 the output of this operation will reach 1,100 tons of mixed tin and tungsten concentrates per year.

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[4] Peko-Wallsend Ltd. (Sydney, Australia). Annual Report 1973–74, 32 pp.

[5] U.S. Embassy, Vienna, Austria. Tungsten—Production/Consumption Statistics. State Department Telegram 5973, July 11, 1975.

[6] Sedlatschek, K. Present Status of Powder Metallurgy in Austria. Internat. J. Powder Met. & Powder Tech., v. 10. No. 2, April 1974, pp. 77–80.

[7] Chiaverini, V. Present Status of Powder Metallurgy in Brazil. Internat. J. Powder Met. & Powder Tech., v. 10, No. 3, July 1974, pp. 153–156.

[8] U.S. Embassy, Rangoon, Burma. Industrial Outlook Report Minerals. State Department Airgram A–075, July 2, 1974.

Canada.—In 1974 tungsten concentrate produced by the Canada Tungsten Mining Corp. Ltd. (CTMC) at Tungsten, Northwest Territories, near the Yukon border, totaled 2.8 million pounds of contained tungsten.[9] Although production increased slightly during the year, the overall recovery was 71.5% compared with 80.2% in 1973. The cause of the decreased recovery in 1974 was the presence of abrasive talc like material in the low-molybdenum scheelite ore which averaged 1.45% WO_3 and presented milling problems. During the year, CTMC produced 168,665 pounds of byproduct copper (Cu) from scheelite ore averaging 0.168% Cu.

Since mid-1974 all mill feed was recovered from the developed underground ore body. This underground source is expected to have a life of 8 years at a milling rate of 600 tons per day. The installation of an underground primary crusher and a conveyor for delivering tungsten ore to the surface mill was expected to be completed by mid-1975. At yearend, the ore reserves were estimated at 4,436,000 tons averaging 1.63% WO_3 and 0.23% Cu.

CTMC's leach plant in North Vancouver, British Columbia, operated during the year at an overall recovery of 98%. One additional tank was added to handle the backlog of material.

Special reports on Canadian tungsten operations and reserves were issued.[10]

China, People's Republic of.—Consumption of tungsten in China is likely to expand. Machine tools and other metal working equipment is expected to account for most of the expansion. Since most of the easily attainable deposits of tungsten are believed to have been worked out, future production will have to come from lower grade and more complex ores. With the development of China as a world trader, it is anticipated that it may purchase mining equipment required to work low-grade underground tungsten ores more effectively.

Japan.—An optimistic evaluation of the Japanese tungsten carbide and metalworking industries was released.[11] The report indicated that these industries are expected to grow substantially once the Japanese Government's tight money policy is relaxed. During the year the Japanese Government indicated that it would develop an economic stockpile of tungsten.

Korea, Republic of.—The Korea Tungsten Mining Co., Ltd. (KTMC), continued to be the country's major tungsten producer in 1974, primarily from the Sangdong mine, and accounted for 93.2% of the total South Korean production during the year.[12] KTMC is owned 15.5% by the Republic of Korea Government. Data on Korean production and stocks of tungsten concentrate and production of APT are indicated in the following tabulation for 1974:

Company	Short tons (gross weight)		
	Concentrate		APT
	Production	Stocks	Production
Kaya Industries Co., Ltd	76	NA	..
Korea Tungsten Mining Co., Ltd	4,298	NA	990
Okbang Mining Co., Ltd	92	NA	--
Other companies[1]	146	NA	--
Total	4,612	642	990

NA Not available.
[1] About 8 mines.

The APT plant located adjacent to the Sangdong mine and concentrator began operation in 1973 and is expected to produce about 1,800 short tons of APT annually by 1976.[13] In December 1974 South Korea began to produce tungsten metal powder and tungsten carbide from domestic concentrate (70% WO_3) and APT (90% WO_3). By 1977 the estimated domestic production of tungsten metal and tungsten carbide, based upon estimated APT consumption, could be 925 short tons.

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[9] Canada Tungsten Mining Corp. Ltd. (Toronto. Canada). 1974 Annual Report. 9 pp.

[10] American Metal Market. Canadian Resources. V. 81, No. 187. Sept. 25. 1974. pp. 7-11.

Johnson. R. F. Tungsten. 1974 Canadian Mineral Yearbook. July 1975. 10 pp.

[11] American Metal Market. Metalworking in Japan. V. 81, No. 127, Sect. 2, July 1, 1974, pp. 1A-8A.

[12] U.S. Embassy, Seoul, Korea. Tungsten Stocks. State Department Airgram A-93. May 6, 1975.

[13] U.S. Embassy, Seoul. Korea. Tungsten—Production/Consumption Statistics. State Department Telegram 5072, July 9, 1975.

Portugal.—Tungsten production, primarily at the Panasqueira mine, of Beralt Tin and Wolfram (Portugal) SARL, a Portuguese company owned 81% by Beralt Tin and Wolfram Ltd. (London), decreased 2% to 2.4 million pounds of contained tungsten during 1974 mainly as a result of the unsettled labor situation.[14] Sales of tungsten concentrate averaging 75.4% WO_3 rose to nearly 4 million pounds of contained tungsten as all of the stockpiled material which had been accumulated in previous years was sold.

The heavy-media separation plant at Barroca Grande and the mill at Rio operated satisfactorily throughout the year with good metal recoveries. Metallurgical tests indicated that it may be possible to increase the recovery of byproduct copper and zinc. Additional tests indicated the possibility of increasing overall tungsten recovery by the production of an additional low-grade concentrate using a high-intensity wet magnetic separation process.

Despite the high level of unemployment in Portugal, the local labor supply improved only marginally although wage increases were awarded by Beralt in an attempt to maintain a stable work force. The major problem continued to be the recruitment of underground miners. Personnel continued to be hired from the Cape Verde Islands during 1974.

Rhodesia, Southern.—Tungsten mining operations at the Beardmore mine and mill operated by the Messina (Transvaal) Development Co., Ltd., ceased in April 1974 when the ore reserve was depleted.[15] During the year, the plant was altered to re-treat slimes and tungsten containing sands. The overall plant recovery was 71.4%. Tungsten recovery at the slimes treatment plant was 32.3% and 42.2% at the sand plant. Production of scheelite concentrate from these low-grade sources totaled 201,000 pounds of contained tungsten. It was anticipated that the stockpiles of low-grade tungsten containing sands and slimes, which can be economically retreated, will be depleted by yearend.

Turkey.—Development of the tungsten deposit at Uludag, 3 miles southeast of Bursa, was continued by Etibank during 1974. When completed and in operation, about 615,000 short tons of ore will be processed annually to produce about 3,300 tons of tungsten concentrate per year.

The Uludag tungsten deposit was reported to contain 10.7 million short tons of proven reserves and 4.2 million tons of probable reserves.[16]

Development of the Uludag tungsten facilities was delayed by a major fire which occurred early in 1975. As a result of this delay, the mine and mill were not expected to become operational before the latter part of 1975.

Yugoslavia.—A brief evaluation of the powder metallurgy industry and its development in Yugoslavia was published early in 1975.[17] Studies of specialized cemented tungsten carbide (WC) powder metallurgy operations at the University of Zagreb formed the nucleus for the development of WC production plants. The two major producers, Prvi Partizan in Titovo Uzice and Sintal in Zagreb, produced about 35,000 pounds of cemented tungsten carbide for the steadily growing Yugoslavian metal-cutting and mining industries.

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[14] Beralt Tin and Wolfram (London). 1974 Annual Report. 19 pp.

[15] Messina (Transvaal) Development Co., Ltd. (Johannesburg, South Africa). 1974 Annual Report, 28 pp.

[16] U.S. Embassy, Ankara, Turkey. Industrial Outlook Report: Minerals. State Department Airgram A-108, June 5, 1974.

[17] Trifunovic, D. Powder Metallurgy in Yugoslavia. Internat. J. Powder Met. & Powder Tech., v. 11, No. 1, January 1975, pp. 67–68.

TECHNOLOGY

Studies were continued by metallurgists of the Bureau of Mines Salt Lake City (Utah) Research Center and by research scientists in industry in an attempt to develop economic methods for recovering tungsten by solvent extraction from low-grade brine deposits (Searles Lake, Calif.), tungsten mill tailings, and tungsten processing sludges.[18] If the tungsten in these sources could be recovered, the domestic reserves would be more than doubled.

Metallurgical engineers at the Bureau of Mines Albany (Oregon) Metallurgy Research Center continued to conduct studies on the ignition hazards of coal-cutter equipment using tungsten carbide bits.[19]

At the Bureau's Twin Cities (Minnesota) Metallurgy Research Center studies were conducted in an attempt to separate and recover titanium tungsten carbide from the tungsten carbide of scrap carbide dies by magnetic fluid density separation methods.

A thorough evaluation of the various commercial methods currently being used to recover cemented tungsten carbide scrap in the United States and Western Europe was reported.[20]

The effects of certain process variables on grain size, grain type, and microhardness of vapor deposited tungsten and tungsten alloys were evaluated.[21]

Physical metallurgical studies of tungsten alloys for high-temperature applications were conducted under Government funding.[22]

[18] Coad, Peter, and John Arthur Hill (assigned to Kerr-McGee Chemical Corp., Oklahoma City, Okla.). Process for the Extraction of Tungsten From an Aqueous Alkaline Solution. U.S. Pat. 3,804,941, Apr. 16, 1974.
Fox, Joseph S. (assigned to Union Carbide Corp., New York). Recovery of Tungsten From Low Grade Tungsten Ore. U.S. Pat. 3,800,025, Mar. 26, 1974.
Nichols, I. L., and R. O. Dannenberg (assigned to the U.S. Department of the Interior). Process for Recovering Tungsten From Alkaline Brines. U.S. Pat. 3,826,808, July 20, 1974.

[19] Blickensderfer, R., D. K. Deardorff, and J. E. Kelley. Incendivity of Some Coal-Cutter Materials by Impact-Abrasion in Air-Methane. BuMines RI 7930, 1974, 20 pp.
Kelley, John E., and Robert Blickensderfer. Spark-Shower Radiance of Metal Grinding Sparks. BuMines RI 7902, 1974, 25 pp.

[20] Winter, D. G. Recovering Tungsten Carbide Scrap. Reclamation Industries Internat., (Croydon, United Kingdom), No. 9, September/November 1974, pp. 46–49.

[21] Donaldson, J. G. Vapor Deposition of Cobalt-Tungsten Alloys. Electrodeposition and Surface Treatment. (Lausanne, Switzerland), v. 2, No. 6, November 1974, pp. 419–434.
Hoertel, F. W. Effect of Certain Process Variables on Vapor Deposited Tungsten. Electrodeposition and Surface Treatment, (Lausanne, Switzerland), v. 2, No. 5, August 1974, pp. 327-341.
Melliar-Smith, C. M., A. C. Adams, R. H. Kaiser, and R. A. Kushner. Chemically Vapor Deposited Tungsten For Semiconductor Metallizations. J. Electrochem. Soc., v. 121, No. 2, February 1974, pp. 298-303.

[22] Simpson, Ronald P., George J. Dooley, III, and T. W. Haas. Study of Grain Boundry Fracture Surfaces in Doped Tungsten-Rhenium Alloys. Metallurgical Trans., v. 5, No. 3, March 1974, pp. 585-591.
Waters, William J., and John C. Freche. A Nickel-Base Alloy, NASA WAZ-16, With Potential for Gas Turbine Stator Vane Application. NASA Tech. Note, NASA TN D-7648, June 1974, 25 pp. Available from National Technical Information Service (NTIS), Springfield, Va.
Zukas, Eugene G., and Leonard S. Levinson. Liquid Phase Sintering of W-Ni-Fe in a Temperature Gradient. Los Alamos Scientific Lab., LA-5665—MS, July 1974, 11 pp. Available from NTIS.
Zukas, Eugene G., and Haskell Sheinberg. Anomalous Sintering Behavior in the 95% W-3.5% Ni-1.5% Fe Composite. Los Alamos Scientific Lab., LA-5730-MS, September 1974, 14 pp. Available from NTIS.

Uranium

By Walter C. Woodmansee [1]

Domestic uranium mine production (in terms of U_3O_8 content in ore) was significantly lower in 1974, compared with that of 1973, principally because lower grade ores were mined and shipped to mills. Mining activity continued high, and the gross ore tonnage produced was greater than that of 1973. Mill production was 13% below the 1973 output. One mill was closed for an indefinite period; another was closed for modernization and expansion; and a third was reopened during the year. At yearend 14 mills were in operation, the lowest number in several years.

Although mine and mill production were lower during 1974, the reduced pace was considered temporary. A number of major new mines and associated mills were planned or under construction in New Mexico and Wyoming, in anticipation of a rapid rise in demand for uranium in the short and long terms. Increasing emphasis was placed on recovering uranium by insitu leaching operations, several of which have emerged as commercial ventures because of improved technology and rising uranium prices. The commercial recovery of uranium from phosphates by the fertilizer industry of central Florida also appeared imminent; one operation was nearing production and others were planned.

Exploration for uranium continued on a large scale, although the success ratio was unimproved. There was increased interest in development of lower grade resources, which may become economic in the near future. According to the Energy Research and Development Administration (ERDA),[2] resources at various forward costs ($8 to $15 per pound U_3O_8) were reduced for the first time in several years, owing to the relatively steep rate of inflation influencing production costs. Resources at costs of $30 per pound U_3O_8, which were first established by AEC in 1973, were also lower. The ERDA office at Grand Junction, Colo., continued its national uranium resource evaluation program, which was planned to provide an improved assessment of potential resources.

In other sectors of the nuclear fuel cycle, uranium enrichment services were increased to both domestic and foreign customers. Delays in developing private nuclear fuel reprocessing facilities may cause a shortage of reprocessing capacity within a few years.

Shortages of investment capital, concern for reactor safety, and energy conservation practices caused further delays in commercial nuclear power development. More than half the nuclear powerplants under construction or scheduled during 1974 were deferred, and a few orders were canceled. Nevertheless, increased development of nuclear power continued to be given high priority in the United States and worldwide. Nuclear power became more attractive from the economic standpoint because of oil price escalation.

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[1] Physical scientist, Division of Nonferrous Metals.

[2] Established under the Energy Reorganization Act of 1974, which abolished the U.S. Atomic Energy Commission (AEC).

Table 1.—Salient uranium statistics

(Short tons U_3O_8 unless otherwise specified)

	1970	1971	1972	1973	1974
Production:					
Domestic:					
Mine:[1]					
Ore ---- thousand tons --	6,324	6,279	6,418	6,537	7,027
Content of ore ----	12,768	12,907	13,667	13,588	[e] 12,400
Average grade of ore percent U_3O_8 --	0.202	0.205	0.213	0.208	[e] 0.176
Recoverable[2] ----	12,190	12,260	12,880	12,901	11,614
Value[3] ---- thousands --	$147,569	$151,996	$162,272	$167,718	$243,884
Mill concentrate[4] ----	12,905	12,273	12,900	13,235	11,528
World[e] [5] ----	24,161	23,903	[r] 25,647	25,635	24,176
Domestic delivery of concentrate, private ----	9,300	12,800	11,600	12,100	11,900
Imports, concentrate ----	665	942	2,329	5,605	1,835
Reserves[6] ---- thousand tons --	300	333	337	340	315
Employment[7] ---- number of persons --	8,165	7,373	6,403	6,595	7,293

[e] Estimate. [r] Revised.

[1] Receipts at mills; excludes uranium from leaching operations, mine waters, and refinery residues.

[2] Based on mill recovery factors.

[3] Market value based on recoverable U_3O_8 content, average AEC price for U_3O_8 (1970 only) and estimated average market price.

[4] Includes marketable concentrate from leaching operations.

[5] Market economies only.

[6] At yearend; maximum forward cost of $10 per pound U_3O_8.

[7] In exploration, mining, and milling at yearend.

Principal source: Energy Research and Development Administration.

Exploration and Reserves.—According to an ERDA survey, 83 active companies reported expenditures of $79 million on exploration in 1974. Total exploration and development drilling footage increased approximately 34% during the year, compared with the 1973 rate. Exploration costs, including drilling, access roads, site preparation, geologic and other technical work, sampling, and logging, ranged from $1 to $12 per foot and averaged $2.07 per foot, a 39% increase over costs in 1973.[3]

Drill rigs were in shorter supply than during the exploration season of 1973. Shortages were also experienced in gamma-logging equipment, supplies, and skilled labor.

Table 2.—Surface drilling for uranium

	1973	1974[e]
Type of drilling:[1]		
Exploration thousand feet --	10,831	16,000
Development ---- do ----	5,590	6,000
Total ---- do ----	16,421	22,000
Number of holes:		
Exploration ----	22,557	27,400
Development ----	11,704	12,300
Total ----	34,261	39,700
Average depth per hole:		
Exploration ---- feet --	480	580
Development ---- do ----	478	490

[e] Estimate.

[1] Does not include claim validation drilling or underground long hole and diamond drilling.

Source: Energy Research and Development Administration.

ERDA reported reductions in reserves and identified (reasonably assured) higher cost resources, but estimates of potential resources were higher than those for 1973. The reduction in reserves was attributed to the effects of inflation and to a reevaluation of data for certain deposits.

Reserves at $10 per pound U_3O_8, which were reduced from 340,000 tons to 315,000 tons, were still concentrated largely in New Mexico and Wyoming, which accounted for 85% of the total identified resources.[4] There were 596 properties having resources at $10 per pound U_3O_8 and 2,118 properties having resources at $30.

The U.S. Geological Survey announced a $4.1 million resource program on uranium-related projects for fiscal 1975, to provide more sophisticated and efficient technology for the discovery of new deposits.

ERDA expanded its National Uranium Resource Evaluation (NURE) program to assess potential uranium resources throughout the United States, including Alaska. NURE funds were increased from $2.2 million in fiscal 1974 to $5.7 million in fiscal 1975. Contract aerial radiometric reconnaissance surveys will cover 125 areas and 741,000 line miles by 1980, using computerized, high-sensitivity, gamma-ray spectrometers and magnetic detectors. The resource program also includes hydrogeochemical studies and the sampling of alluvial sediments. Participants will incude ERDA's national laboratories, universities, State agencies, the U.S. Geological Survey, and the Environmental Protection Agency. Data on the airborne and geochemical studies will be placed on open file following completion of each survey.[5]

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[3] Energy Research and Development Administration, Grand Junction Office. Uranium Exploration Expenditures in 1974 and Plans for 1975–76. GJO-103 (75), Grand Junction, Colo., 11 pp.

[4] Energy Research and Development Administration, Grand Junction Office. ERDA Estimates U.S. Uranium Reserves. News Release No. 5, Mar. 21, 1975, Grand Junction, Colo., 6 pp.

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[5] Patterson, J. A. U.S. Uranium Situation. Energy Research and Development Administration. Paper pres. at Atomic Ind. Forum Fuel Cycle Conf. 1975, Atlanta, Ga., Mar. 20, 1975, 10 pp.; available for reference from Division of Nuclear Fuel Cycle and Production, U.S. Energy Research and Development Administration, Washington, D.C.

Table 3.—Domestic uranium resources at various estimated costs[1]

(Thousand tons U_3O_8)

	Forward costs			
	$8	$10	$15	$30
Identified resource	[2] 200	[2] 315	420	600
Potential resource	530	960	1,530	2,890

[1] Yearend 1974; higher cost resource includes that at lower cost.

[2] Reserves at estimated costs and average market prices in 1974.

Source: Energy Research and Development Administration.

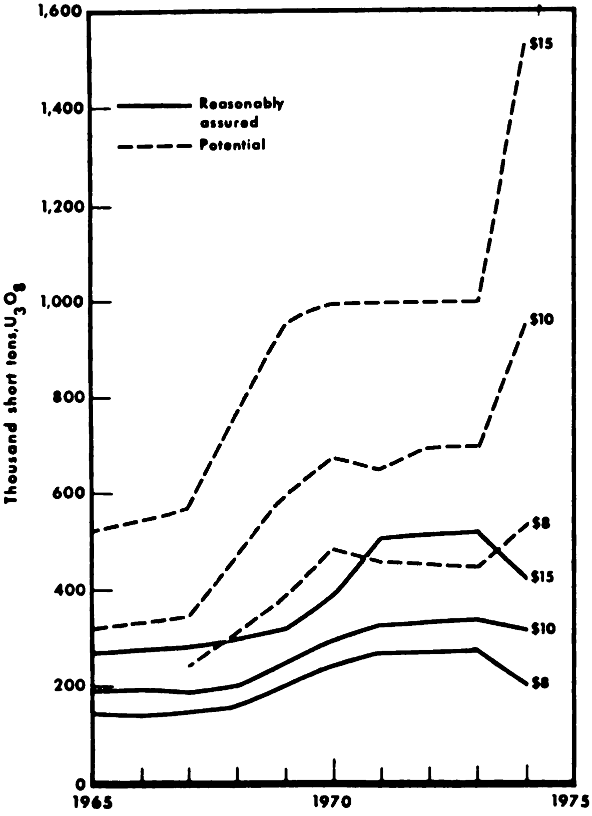

Figure 1.—Domestic uranium resources at various cutoff costs.

Table 4.—Domestic uranium reserves, by State [1]
(Thousand tons)

State	Gross weight of ore	Grade (Percent U_3O_8)	U_3O_8 in ore
New Mexico	74,800	0.22	168
Wyoming	62,200	.16	102
Colorado	2,900	.28	8
Utah	2,800	.21	6
Other [2]	24,900	.12	31
Total	167,600	.19	315

[1] Based on maximum cutoff cost of $10 per pound U_3O_8; data as of yearend 1974.
[2] Includes Alaska, Arizona, California, Montana, North Dakota, Oregon, South Dakota, Texas, and Washington; combined to avoid disclosing individual company confidential data.

Source: Energy Research and Development Administration.

PRODUCTION

Mine.—Gross uranium ore output was higher than that of 1973, but the average ore grade and recoverable U_3O_8 content were markedly reduced. ERDA preliminary data indicated production, by State, as follows:[6]

State	Mine production [1]	
	Ore (thousand tons)	U_3O_8 content (tons)
New Mexico	2,997	5,400
Wyoming	2,458	4,000
Other [2]	1,661	3,200
Total	7,116	12,600

[1] Includes output of approximately 200 tons U_3O_8 from mine waters and leaching operations.
[2] Colorado, Texas, Utah, and Washington; combined to avoid disclosing individual company confidential data.

About 58% of this output was from open pit mines, 40% from underground mines, and 2% from leaching operations and recovery from mine waters. There were 123 underground mines, 31 open pits, and 19 miscellaneous operations.

Several large new mines were under development in New Mexico and Wyoming. Gulf Mineral Resources Inc., a division of Gulf Oil Corp., started construction of surface facilities in the eastern Grants mineral belt, McKinley and Valencia Counties, N. Mex. Late in the year, plans for shaft sinking were being made. The mine will be served by a 24-foot-diameter, concrete-lined, exhaust vent and ore-hoisting vertical shaft and a 14-foot-diameter, steel-lined, man-hoisting and intake vent vertical shaft. The shafts will be bottomed at 3,500 feet. A mining rate of 5,000 tons of ore per day will yield 9 million pounds U_3O_8 per year. Reported reserves were 100 million pounds U_3O_8.[7]

In May a circular shaft, 14 feet in diameter, was completed at a depth of 1,377 feet at the Johnny M mine of Ranchers Exploration & Development Corp. and HNG Oil Co., also in the Grants district, New Mexico. The mine is situated between the main producing area and the Gulf deposit, 20 miles northeast of Grants. At yearend drifting was underway to the ore body north and south of the main shaft. The ore mining rate will be 700 tons per day, starting in 1975. Ore will be processed at the Kerr-McGee Nuclear Corp. mill in the district.[8]

Fluor Utah, Inc. received a contract for the mine and mill complex of Standard Oil Co. (Ohio) and Reserve Oil & Minerals Corp. at the L-Bar Ranch property, Valencia County, N. Mex. The property is 2 miles northeast of the Jackpile mine. Late in the year, the surface plant was under construction, and a circular shaft,

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[6] Energy Research and Development Administration, Grand Junction Office. Statistical Data of the Uranium Industry. GJO-100 (75), Jan. 1, 1975. pp. 24-28.

[7] Engineering and Mining Journal. V. 175, No. 11, November 1974, p. 204.

[8] Skillings, D. N., Jr. Ranchers' Johnny M Uranium Development in New Mexico. Skillings Min. Rev., v. 63, No. 25, June 22, 1974, pp. 1, 4-7.

14 feet in diameter, was collared and ready for sinking to a depth of about 650 feet. The planned ore mining rate was 1,000 tons per day.

In the Church Rock area near Gallup, N. Mex., Kerr-McGee Nuclear Corp. and United Nuclear Corp. also had mines under development.

Kerr-McGee Nuclear Corp. terminated its uranium-mining operations at Shirley Basin, Wyo., and completed land reclamation there in December. At a site 40 miles northeast of Casper, Wyo., in the Powder River Basin, the Bill Smith mine shaft was at 860 feet late in the year. Total planned depth was 950 feet. The mine was scheduled for production in 1976.[9]

At the Exxon Nuclear Co. Highland operation, northwest of Douglas, Wyo., also in the Powder River Basin, a 704-foot vertical shaft, bottomed in November, will serve two mines. Underground development will total 11,000 feet. The operation will produce 1 million tons of ore per year, starting in 1977.[10]

Leased Public Lands.—Mining leases on 43 ERDA-controlled tracts, comprising 25,000 acres, were granted to 26 companies during the year. These public lands are located in southwestern Colorado (38), southeastern Utah (4), and New Mexico (1). On April 23 eight tracts in Montrose County, Colo., were leased; bids on 18 tracts for leasing only to small business enterprises were opened on May 15; and bids on the remaining 17 tracts were opened July 1. The bid to one remaining tract not previously leased was opened on August 26. These lands contain substantial uranium reserves developed by AEC-sponsored exploration on withdrawn lands during the 1950's.

Byproduct Uranium.—An estimated 3.5 million to 4 million pounds U_3O_8 were considered recoverable annually from the wet process phosphoric acid operations of six large phosphatic fertilizer producers in central Florida.[11] Additional quantities could also be recovered from the numerous small operations and from the exported phosphate rock, which constitutes about one-fourth of the output.

Uranium Recovery Corp., a subsidiary of United Nuclear Corp., started construction of a commercial-scale facility at a phosphoric acid plant in Bartow, Fla., in February and planned a second onsite facility, near Mulberry, Fla., 30 miles east of Tampa. A central processing facility will produce 1,000 tons U_3O_8 per year.

Gulf Oil Chemicals Co. operated a mobile demonstration uranium extraction plant at acid process streams near Fort Pierce and Bartow during the year. A recovery process, developed by Gulf Research & Development Co., was being tested. Gulf reported a 96% uranium recovery and a probable viable operation at $7 to $8 per pound U_3O_8.[12]

A third potential producer, Westinghouse Electric Co., was negotiating with phosphate fertilizer producers for an associated uranium operation.

Mill.—Output of U_3O_8 in concentrate was sharply reduced in 1974, owing principally to the processing of lower grade ores. According to ERDA the average milfeed grade was 0.18% U_3O_8, compared with 0.20% in 1973. Because of higher uranium prices, low-grade stockpiles (down to 0.05% U_3O_8) were fed to process, resulting in a reduction in overall average mill recovery from nearly 94% in 1973 to about 93% in 1974. At yearend total operable milling capacity was 25,800 tons of ore per day and about 17,000 tons U_3O_8 per year. The mills were operated at about 80% of capacity. Fourteen mills were in operation, compared with 20 mills in 1972 and 18 mills in 1973.

Table 6 indicates the mill status at yearend 1974. The Western Nuclear Inc. plant at Jeffrey City, Wyo., was in a 2-year expansion program to 1,400 tons of ore per day and 2 million pounds U_3O_8 per year.[13] Atlas Corp. started a new carbonate circuit, and a new 500-ton-per-day acid circuit, designed for vanadium recovery, was being installed.

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[9] The Mining Record. Kerr-McGee Nuclear Shifting Emphasis on Uranium Operations. V. 85, No. 47, Nov. 27, 1974, p. 1.

[10] The Mining Record. Exxon's Highland Uranium Operations Complete Shaft. V. 85, No. 46, Nov. 20, 1974, p. 1.

[11] Engineering and Mining Journal. Uranium Extraction From Phosphoric Acid Under Active Consideration. V. 175, No. 9, September 1974, pp. 44, 201.

[12] Nucleonics Week. Gulf Sees Uranium From Phosphates Profitable at Prices of $7/lb. U_3O_8. V. 15, No. 17, Apr. 25, 1974, p. 11.

[13] The Mining Record. Phelps Dodge Western Nuclear Unit To Begin Expansion. V. 85, No. 16, Apr. 17, 1974, p. 5.

Table 5.—Domestic uranium mill statistics in 1974

(Short tons U_3O_8 unless otherwise specified)

Operating mills, yearend	number	14
Average daily milling rate	tons or ore	23,000
Mill receipts, content of ore		12,413
Mill feed:		
Content of ore		12,242
Other [1]		200
Total		12,442
Recovery rate	percent	93
Production		11,528
Shipments		12,464
Stocks:		
Content of ore, Jan. 1, 1974		113
Content of ore, Dec. 31, 1974		284
Concentrate, Jan. 1, 1974		5,238
Concentrate, Dec. 31, 1974		4,302
In process:		
Concentrate, Jan. 1, 1974		328
Concentrate, Dec. 31, 1974		440

[1] Concentrate from leaching operations, mine waters, refinery residues, recycled tailings, and cleanup.

Source: Energy Research and Development Administration.

Table 6.—Operating domestic uranium milling companies and facilities in 1974

Company	Plant location	Capacity (tons of ore per day)
The Anaconda Company	Bluewater, N. Mex	3,000
Atlas Corp [1]	Moab, Utah	1,500
Continental Oil Co.—Pioneer Nuclear, Inc	Falls City, Tex	1,750
Cotter Corp	Canon City, Colo	450
Dawn Mining Co	Ford, Wash	500
Exxon Nuclear Co	Powder River Basin, Wyo	2,000
Federal Resources Corp.—American Nuclear Corp	Gas Hills, Wyo	950
Kerr-McGee Corp	Grants, N. Mex	7,000
Petrotomics Co [2]	Shirley Basin, Wyo	1,500
Rio Algom Mines Ltd	La Sal, Utah	500
Union Carbide Corp	Uravan, Colo	1,300
Do	Natrona County, Wyo	1,000
United Nuclear Corp.—Homestake Mining Co	Grants, N. Mex	3,500
Utah International, Inc	Gas Hills, Wyo	1,200
Do	Shirley Basin, Wyo	1,200
Western Nuclear Inc [3]	Jeffrey City, Wyo	1,200

[1] On standby, undergoing modification and expansion in January; reopened in September.
[2] Closed for indefinite period in October.
[3] Closed for modification and expansion.

Source: Energy Research and Development Administration.

In addition to mill closures and ongoing modifications and expansions, new mills were scheduled at three major developing mine sites in New Mexico. At the L-Bar Ranch mine, Laguna area, Standard Oil Co. (Ohio)-Reserve Oil & Minerals Corp. planned a 1,000-ton-per-day mill, operable in 1976. United Nuclear Corp. planned to start construction of a 3,000-ton-per-day facility at its Church Rock mine area in 1975. Gulf Mineral Resources Inc. planned milling facilities at its uranium mine under development in the Grants district.

Commonwealth Edison Co., the Chicago-based utility company, acquired control of the Cotter Corp. uranium operation, including the mill at Canon City, Colo. The Tennessee Valley Authority (TVA) acquired the inactive mill at Edgemont, S. Dak., and other uranium properties formerly held by the Susquehanna Corp.

Uranium Hexafluoride (UF_6).—The conversion plant (U_3O_8 to UF_6) of Kerr-

McGee Nuclear Corp. at Sequoyah, Okla., was scheduled for a doubling of capacity (from 5,000 tons uranium equivalent per year to 10,000 tons per year) by 1978. Kerr-McGee concluded a $26 million contract with TVA for conversion of 26.9 million pounds U_3O_8.

According to ERDA the available annual conversion capacity of 24,000 tons of uranium after the Kerr-McGee expansion, including 14,000 tons of uranium at the plant of Allied Chemical Corp. at Metropolis, Ill., will be sufficient until about 1979.

Enriched Uranium.—ERDA reported total enrichment revenues of $497.6 million in fiscal 1974, including $272.9 million for nearly 7 million separative work units (SWU)[14] to 20 domestic and 16 foreign customers and $224.7 million in advanced payments under long-term fixed-commitment contracts.

Eight industrial organizations were participating in ERDA's Domestic Access Program and Access Permit Program, which provided access to ERDA's classified enrichment technology for qualified companies. Engineering studies were underway to demonstrate the economics of the production of enriched uranium by gas-centrifuge methods. A component test facility, equipment test facility, and component preparation laboratories were under construction at Oak Ridge, Tenn., and probably elsewhere under the Centrifuge Development Program.[15]

Several companies announced withdrawals from joint ventures for private uranium enrichment because of the uncertainties in future demand for enrichment services. Late in the year Westinghouse Electric Corp. and Union Carbide Corp. withdrew from Uranium Enrichment Associates (UEA) following completion of an engineering design for a $2.75-billion, 9-million-SWU, gaseous-diffusion plant. In July, UEA took an option on land in Houston County, Ala., for this plant.[16] The remaining partner, Bechtel Corp., was seeking new participation. In September General Electric Co. announced a decision to withdraw from Cengex Associates, which was designing prototype production facilities for centrifuge enrichment. Exxon Nuclear Co. was the other member. In November Electro-Nucleonics Inc. and Atlantic Richfield Co. formed Centar Associates, which announced a joint study for a 300,000-SWU enrichment facility, also by centrifuge methods.

Effective June 30, 1974, AEC announced a temporary suspension of new long-term contracts for enrichment services, pending a review of projected capacities and demand. In order to encourage private development of new enrichment capacity, AEC offered to consider the payment of cash differentials between company and customer terms and the support of private capacity with AEC preproduction stocks.

The ongoing ERDA Cascade Improvement Program and Cascade Uprating Program will expand annual capacity from 17.2 million SWU to 27.7 million SWU by 1980 with new equipment and increased power levels. This capacity was expected to be adequate until the mid-1980's. ERDA planning was under review because of new factors influencing future demand—reactor deferrals and delays, foreign enrichment capacity, setbacks in fuel reprocessing and plutonium recycle, and the rush of new orders in 1974 for enrichment services because of the petroleum crisis.[17]

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[14] Measure of work expended in separating a quantity of uranium (in kilograms) at a given assay into two fractions—one enriched in U_{235} to a specified grade and the other deficient in U_{235} to a specified tailings grade.

[15] Baranowski, F. B. U.S. Gas Centrifuge Program Advances Beyond Development Stage. U.S. Atomic Energy Commission, No. S-1-74, Mar. 5, 1974, 11 p.

[16] Nuclear News. UEA Options Alabama Site for Diffusion Plant. V. 17, No. 10, August 1974, pp. 65–66.

[17] Chemical Engineering. Uranium Enrichment in for Decade of Expansion. V. 82, No. 6, Mar. 17, 1975, pp. 24–26.

Table 7.—Domestic processing and production facilities for uranium nuclear fuels in 1974

Company	Location	Product or service
Allied Chemical Corp	Metropolis, Ill	UF_6.
Allied General Nuclear Services, Inc.	Barnwell, S.C	Reprocessing;[1] conversion enriched U to UF_6.[1]
Babcock & Wilcox Co	Lynchburg, Va	UO_2;[1] UO_2 pellets; fabrication of UO_2 and Pu fuels.
Combustion Engineering Inc	Windsor, Conn	UO_2 pellets; fabrication of UO_2 and Pu[1] fuels.
Do	Hematite, Mo	UO_2; UO_2 pellets.
Exxon Nuclear Co	Richland, Wash	Reprocessing;[2] UO_2; UO_2 pellets; fabrication of UO_2 and Pu fuels; U[1] and Pu scrap.[1]
General Atomic Co	San Diego, Calif	Fabrication of carbide and special fuels.
Do	Youngsville, N.C	Fabrication of carbide[1] and special fuels.[1]
Do	[2]	Reprocessing;[1] fabrication of U_{233} fuels.[1]
General Electric Co	Morris, Ill	Reprocessing;[2] conversion enriched U to UF_6.[2]
Do	San Jose and Vallecitos, Calif.	Fabrication of Pu fuels; U and Pu scrap.
Do	Wilmington, N.C	UO_2; UO_2 pellets; fabrication of UO_2 fuels; U scrap.
Goodyear Atomic Corp.[3]	Portsmouth, Ohio	Enriched UF_6.
Kerr-McGee Corp	Cimarron, Okla	UO_2; UO_2 pellets; fabrication of UO_2, special and Pu fuels; depleted U metal and compounds; U scrap.
Do	Sequoyah, Okla	UF_6.
NL Industries, Inc	Albany, N.Y	Depleted U metal.
North American Rockwell Corp., Atomics International Div.	Canoga Park, Calif	Fabrication of carbide, special, and Pu fuels; depleted U compounds and metal; Pu scrap.[1]
Nuclear Fuel Services, Inc	Erwin, Tenn	UO_2; UO_2 pellets; fabrication of carbide, U_{233}, and Pu fuels; depleted U metal and compounds; U and Pu scrap.
Do	West Valley, N.Y	Reprocessing;[4] enriched U to UF_6.[1]
Nuclear Materials and Equipment Corp. (NUMEC)	Apollo, Pa	UO_2; UO_2 pellets; fabrication of UO_2 fuels; depleted U compounds; U scrap; highly enriched U to UF_6.
Do	Leechburg, Pa	Fabrication of carbide, special, U_{235}, and Pu fuels; depleted U metal; Pu scrap.
Tennessee Nuclear Specialties, Inc.	Jonesboro, Tenn	Depleted U metal and compounds.
Texas Instruments Inc	Attleboro, Mass	Fabrication of special fuels.
Union Carbide Corp.[3]	Oak Ridge, Tenn	Enriched UF_6.
Do[3]	Paducah, Ky	Do.
United Nuclear Corp	Wood River Junction, R.I	
United States Nuclear Corp	Oak Ridge, Tenn	Fabrication of special fuels.
Westinghouse Electric Corp	Cheswick, Pa	Fabrication of carbide and Pu fuels; Pu scrap.
Do	Columbia, S.C	UO_2; UO_2 pellets; fabrication of UO_2 fuels; U scrap.[1]
Do	Anderson, S.C	Fabrication of Pu fuels;[1] Pu scrap.[1]
Whittaker Corp., Nuclear Metals Div.	West Concord, Mass	Fabrication of special fuels; depleted U metal.

[1] Under construction or planned.
[2] Undetermined.
[3] Contractor for Energy Research and Development Administration.
[4] On standby; facilities under modernization and expansion.
Principal source: Energy Research and Development Administration, Office of Industry Relations.

Fuel Fabrication.—Several significant developments took place among the nuclear fuel manufacturers. General Atomic Co. sold its oxide fuel facility at Hematite, Mo., to Combustion Engineering Inc.; transferred its equipment from the plant at New Haven, Conn., to San Diego, Calif.; negotiated with Babcock and Wilcox concerning transfer of fuels contracts to that company; and sold its equipment and contracts for special metallic fuels to U.S. Nuclear Co. Exxon Nuclear Co. completed an expansion at Richland, Wash.

ERDA reported that 2,076 tons of enriched UF_6 was shipped for domestic nuclear fuel use and 794 tons to foreign agencies in fiscal 1974, compared with 1,613 tons and 880 tons, respectively, in fiscal 1973.

Fuel Reprocessing.—As in 1973 there was no operable commercial spent fuels reprocessing capacity during 1974. Construction at the 1,600-ton-per-year facility of Allied General Nuclear Services, Inc., at Barnwell, S.C., reportedly was 80% completed, and the plant was scheduled for operation in 1976. This capacity could serve approximately 60 commercial reactors. The only other plant expected to be in operation before 1980—that of Nuclear Fuel Services, Inc., at West Valley, N.Y.—has been closed since 1972 and was under modification to improve environmental protection and was under expansion to 825 tons per year. In July General Electric Co. announced that its new plant at Morris, Ill., which employed new reprocessing technology, was not operable. No plans were made for further work there.

ERDA projections indicated a shortfall in reprocessing capacity continuing through 1985. The situation could be worsened by further slippages in scheduled future capacities. The principal reasons given for the insufficient planned commercial capacity were the uncertainties in Government policy and licensing requirements for plutonium recycle and waste management and problems in investment capital. A backlog of 8,800 tons of unprocessed spent fuel was anticipated, containing 70 tons of plutonium that would not be available for recycle. This would be equivalent to the need for an additional 10,000 tons U_3O_8.[18]

Waste Management.—An ERDA decision was pending on the disposal and control of high-level radioactive wastes, generated during spent fuels reprocessing. A Retrievable Surface Storage Facility (RSSF) with continual surveillance was favored as an interim procedure with either water-immersion or air-convection cooling and sealed-cask storage. As a permanent measure, the concept of underground storage in salt beds was still preferred. In September ERDA issued a draft Environmental Impact Statement (EIS) on the various options in waste management.[19] Public hearings were held in November and December, and a final EIS was in preparation at yearend. ERDA estimated that the cost for waste management to the end of the century would be on the order of $2.5 billion to $3 billion.

Three commercial companies operated six burial sites for low-level wastes on State and Federal lands. An estimated 1.8 million cubic feet of commercial low-level wastes were buried at these sites during 1974, and 1.3 million cubic feet were buried at ERDA facilities.[20]

CONSUMPTION AND USES

During 1974 the domestic commercial nuclear power industry was beset by problems in raising capital and in public concern for reactor safety. In addition energy conservation practices resulted in reduced energy forecasts, which added to delays in nuclear powerplant schedules. Numerous reactor deferrals and a few cancellations were announced. Deferrals affected more than half of the nuclear powerplants under construction or planned during the latter half of the year. As a result, ERDA's short-term (to 1985) demand projections were reduced from earlier forecasts, but the long-term forecast (to 2000) was little affected.

Despite these adverse factors, the industry continued to move forward. According to ERDA 14 plants (11,800 Mw) became operable, the highest number for any year to date. Domestic reactor status was as follows, at yearend:

Status	Number of installations	Capacity (megawatts electric)
Operable	[1] 55	36,810
Under construction	73	73,840
Planned	107	122,070
Total	235	232,720

[1] Includes two ERDA-owned plants.

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[18] Nuclear Ind. AEC Discusses Plutonium Recycle Regulatory Actions Now Underway—The Reprocessing Lag. V. 21, No. 4, April 1974, pp. 30–31.

[19] Chemical and Engineering News. AEC Eyes Disposal of Radioactive Wastes. V. 52, No. 38, Sept. 23, 1974, p. 7.

[20] Energy Research and Development Administration. The Nuclear Industry 1974, WASH-1174-74, pp. 64–73.

This compares with 199 units and 187,779 Mw at yearend 1973. The setbacks in schedules and planning in 1974 were reflected in a sharp reduction in reactor orders or letters of intent (22 in 1974, 46 in 1973, and 36 in 1972), according to a study conducted by the American Nuclear Society.[21]

Table 8.—Current and projected domestic U_3O_8 demand [1]
(Short tons)

Year	Demand	
	Annual	Cumulative
1974	9,700	9,700
1975	10,800	20,500
1976	14,100	34,600
1977	17,500	52,100
1978	20,500	72,600
1979	23,200	95,800
1980	25,800	121,600
1985	50,900	328,900
2000	172,800	2,046,700

[1] Feed materials required for enrichment services. Enrichment tails assays—0.20% to July 1, 1976, 0.275% to July 1, 1981, and 0.30% thereafter.

Source: Energy Research and Development Administration.

An ERDA survey of uranium producers, utility companies, and reactor manufacturers indicated reduced uranium-buying activity and a sharply lower rate of increase in delivery commitments.[22] Consumers experienced difficulties in finding available supplies. The prevailing sellers' market was a reversal of the buyers' market existing in previous years.

Organizations were formed or in planning to pool enriched uranium purchases. The World Nuclear Fuel Market, which had 50 charter members including foreign members, was formed by the Nuclear Assurance Corp. A Separative Work Administration Pool comprised 12 utility companies. A Separative Work Units Corp. was organized by the Nuclear Exchange Corp. A fourth agency was the NUS Corp.

Table 9.—Current and projected domestic commercial uranium delivery commitments
(Short tons U_3O_8)

Year	Commitments [1]	
	Annual	Cumulative
1974	11,900	[2] 67,500
1975	15,600	83,100
1976	12,600	95,700
1977	12,700	108,400
1978	15,300	123,700
1979	13,900	137,600
1980	11,600	149,200

[1] In the post-1980 period, through 1994, an additional 42,100 tons have been committed. In addition, 10,600 tons have been committed to foreign buyers, of which 7,000 tons were delivered prior to yearend 1974.

[2] Pre-1974 deliveries were 55,600 tons.

Source: Energy Research and Development Administration.

Table 10.—Uranium fuel supply arrangements for domestic nuclear reactors [1]
(Percent of total nuclear generating capacity)

Source of supply	First core	Reloads [2]											
		1	2	3	4	5	6	7	8	9	10	11	12
Primary producers	30	29	25	22	17	17	11	6	4	4	2	1	1
Reactor manufacturers	27	25	21	18	14	10	8	6	4	2	2	2	2
Imports	4	4	4	4	6	4	4	6	6	7	7	8	6
Total	61	58	50	44	37	31	23	18	14	13	11	11	9

[1] As of yearend 1974. Includes reactors operating, under construction, and scheduled totaling 216,000 Mw. Does not include leases from AEC, which are small, comprising less than 0.2% for first cores and for refueling through sixth reload, when they are scheduled to terminate.

[2] Refueling estimated on annual basis.

Source: Energy Research and Development Administration.

Late in 1973 Offshore Power Systems Inc. (Westinghouse Electric Corp. and Tennessee Oil Co.) started dredge-and-fill operations at Jacksonville, Fla., for its manufacturing plant for barge-mounted nuclear powerplants at offshore sites. Construction continued on schedule for completion in late 1975 and first delivery in 1979. However, plans for the first offshore sites in coastal New Jersey may be delayed by as much as 5 years, and other orders or letters of intent remained uncertain.

Studies were underway on the feasibility of nuclear energy centers (NEC), which would include a concentration of nuclear powerplants, process heat for other industries, nuclear fuels manufacturing, fuels reprocessing, and waste management, all at one site. Authorities considered that the NEC concept may alleviate some reactor-safety problems and may also provide better safeguard practices against undesirable diversion of plutonium or enriched uranium.

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[21] Nuclear News. V. 18, No. 3, mid-February 1975, p. 17.

[22] Energy Research and Development Administration. Survey of United States Uranium Marketing Activity. ERDA-24, April 1975, 26 pp.

Depleted Uranium.—A penetrator for use in ammunition for Phalanx, a naval gun system under research and development, was made from depleted uranium (DU). DU is processed from UF_6 gas, the form in which it occurs in enrichment plant tailings, to a metallic rod form from which the penetrators are cut and worked to specifications.[23]

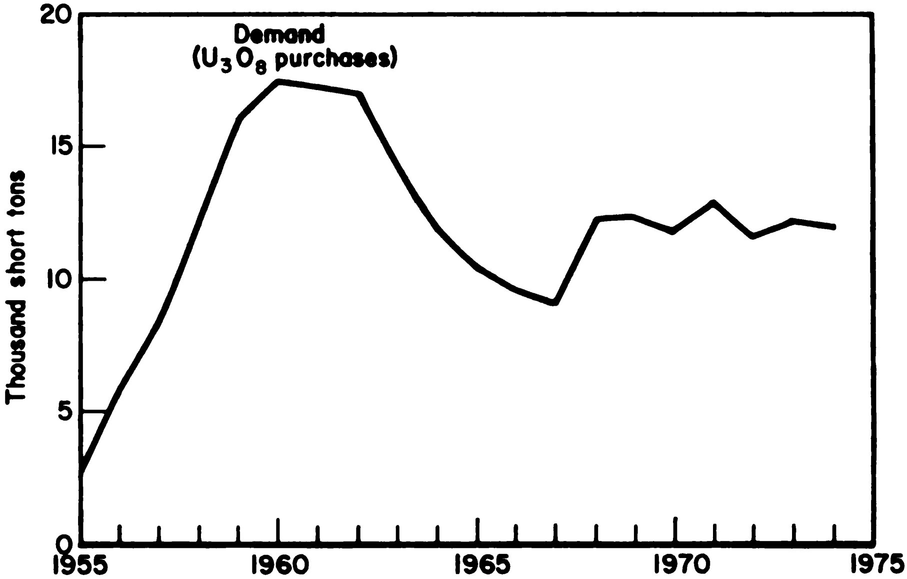

Figure 2.—Domestic uranium demand.

STOCKS

Total stocks held by the producers, or milling companies, were reduced during 1974, whereas those held by the consuming industry were slightly higher, as indicated in the following data provided by ERDA (in tons U_3O_8):

	Jan. 1, 1974	Dec. 31, 1974
In ore at mills	113	284
In process at mills	328	440
In concentrate at mills	5,238	4,302
In concentrate held by utility companies, reactor manufacturers, and agents (including equivalent U_3O_8 in UF_6)	19,900	20,200
Total	25,579	25,226

The stockpile of DU continued to grow as a result of large-scale enrichment services provided for domestic and foreign customers. ERDA announced that 220,000 tons of DU had accumulated in the form of UF_6.

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[23] Tabb, B. H., Jr. Phalanx and Its Ammunition. Nat. Defense, March–April 1975, pp. 399–401.

PRICES

The prices for spot sales and future delivery of U_3O_8 in concentrate continued to escalate during 1974. According to the Nuclear Exchange Corp. (Nuexco), the bid price was $7 per pound U_3O_8 for delivery in January and $15 at yearend. During this period, the bid price for delivery in 1980 increased from $12 to $25.35.[24]

An AEC survey illustrated the significantly lower U_3O_8 prices paid by reactor manufacturers and utility companies in contracts negotiated from 1967 to mid-1974.[25] Under the terms of these early contracts, the average price was $7.65 per pound for delivery in 1974 (current price in year of delivery) and $11.40 in 1980. The AEC commented that this survey involved only a small part of projected requirements to 1980 and was not indicative of prices in contracts later in 1974, which were higher.

The strong seller's market developing in 1974 was reflected in newly negotiated contracts, many of which called for prepayments, price adjustment, or price renegotiation at time of delivery. High future uranium prices were indicated in a number of sales contracts announced during the year. Rio Algom Mines, Canada, concluded contracts for delivery during the 1980's at an average price of $20 per pound U_3O_8, subject to escalation and to a Canadian Government requirement that the price be tied to the prevailing world market price at time of delivery. A contract between Western Nuclear Inc. and a European customer was for 2.5 million pounds at $9 per pound for delivery in 1974 and $12 for delivery in 1977, subject to possible 100% escalation. Reported contract terms for sales by Kerr-McGee Corp. to domestic and foreign customers were in the $15- to $16-per-pound range for delivery in the late 1970's. Other sales appeared to be in the range of $13 to $16 per pound for delivery during 1975–80, also subject to price escalation.

Effective December 18, 1974, AEC announced higher prices for enrichment services because of increasing actual and projected costs, primarily for electric power. For the old requirements-type contracts the price, per SWU, was increased from $39.30 to $47.80. Under the new long-term fixed-commitment contracts, the new price, per SWU, was $42.10 (formerly $36.80). Starting in mid-1975, an automatic 2% increase will take place every 6 months.

In August AEC announced plans to request revision of the Atomic Energy Act and the Uranium Enrichment Services Act in order to establish a commercial charge for enrichment services. Existing AEC policy was for cost-recovery pricing, whereas forecasts for the developing private enrichment services were much higher (estimated average $75 per SWU, subject to escalation from 1974, over a 25-year fixed-commitment contract).[26]

FOREIGN TRADE

Uranium was imported in the form of U_3O_8 for conversion of UF_6 and enrichment, and as UF_6 for enrichment. Exports of the enriched uranium product are included in special nuclear materials. Imports of U_3O_8 concentrate were lower in 1974, but imports of other compounds (UF_6) were higher.

In the Federal Register of November 27, 1973 (38 CFR 32595), AEC proposed a revision of the Uranium Enrichment Services Criteria as they apply to the restriction on enrichment of feed materials of foreign origin for use in domestic facilities, pursuant to Subsection 161V of the Atomic Energy Act of 1954, as amended. The proposal was for a gradual relaxation and eventual termination of the restriction according to the following schedule:

Year	Maximum annual feed material of foreign origin, per customer (percent)
1977	10
1978	15
1979	20
1980	30
1981	40
1982	60
1983	80
1984	100

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[24] Nuclear Exchange Corp. Nuexco Monthly Report to the Nuclear Industry. No. 77, Dec. 19, 1974, pp. 1, 2.

[25] U.S. Atomic Energy Commission, Grand Junction Office. AEC Survey Shows Increasing Uranium Prices. News Release No. 671, Grand Junction, Colo., Oct. 22, 1974, 3 pp.

[26] Nucleonics Week. AEC Will Ask JCAE to Allow "Commercial" Enrichment Charges. V. 15, No. 28, July 11, 1974, p. 3.

Table 11.—Foreign trade in uranium, uranium-bearing materials, and other nuclear materials, by principal country

Product	1973 Quantity	1973 Value	1974 Quantity	1974 Value	Principal sources and destinations, 1974
EXPORTS					
Uranium:					
Ores and concentrates, U_3O_8 content pounds	109,934	$736,560	--	--	
Compounds do	4,028,095	26,107,130	4,682,926	$30,855,227	Canada 3,231,748; United Kingdom 576,392; France 498,673; Italy 348,819; Japan 20,788.
Metal including alloys [1] do	14,737	269,708	20,496	321,982	Italy 9,606; Canada 8,791; Japan 1,348.
Isotopes (stable) and their compounds	NA	17,041,107	NA	2,786,077	Pakistan $624,750; West Germany $349,112; Brazil $330,448; Canada $250,610; United Kingdom $249,922; Australia $167,509; Netherlands $162,391; Japan $139,672.
Radioactive materials:					
Radioisotopes, elements, and compounds [2] thousand curies	15,615,135	12,302,891	25,431,262	16,571,478	Canada 6,885,718; West Germany 4,399,658; Sweden 2,453,655; Mexico 725,826; Norway 608,276; Switzerland 496,465.
Special nuclear materials [3]	NA	223,516,224	NA	158,266,718	Japan $30,297,569; West Germany $21,453,837; Taiwan $18,316,439; Sweden $18,019,502; France $17,133,282; United Kingdom $14,602,438; Italy $10,076,262; Switzerland $10,007,580.
IMPORTS					
Uranium:					
Oxide (U_3O_8) pounds	11,210,066	61,442,214	3,670,678	30,284,189	Canada 3,631,882; United Kingdom 38,786; Switzerland 10.
Other compounds do	10,914,684	82,859,653	12,866,822	90,921,175	France 5,549,729; Canada 5,331,017; United Kingdom 1,985,830; West Germany 246.
Isotopes (stable) and their compounds	NA	807,578	NA	1,007,342	Canada $397,754; U.S.S.R. $187,852; Japan $118,858; United Kingdom $96,596; Israel $71,845; West Germany $58,378; France $42,961.
Radioactive materials:					
Radioisotopes, elements, and compounds [4] thousand curies	34,672,001	5,536,645	24,246,498	7,564,834	Canada 10,847,024; France 9,003,888; Switzerland 3,013,959; United Kingdom 1,057,548.

NA Not available.
[1] Includes thorium.
[2] Includes carbon-14 and cobalt-60.
[3] Includes plutonium, uranium-233, and enriched uranium.
[4] Includes cobalt-60.

Public comment was sought by February 25, 1974. The proposal was submitted to the Joint Committee on Atomic Energy on August 13, 1974, and was scheduled to become effective on October 25, 1975.[27]

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[27] U.S. Atomic Energy Commission. AEC Puts Into Effect its Previously Announced Plan To Remove Restrictions on Enrichment of Foreign Uranium for Domestic Use. News Release No. T-517, v. 5, No. 44, week ending Oct. 30, 1974, pp. 7–8.

WORLD REVIEW

Because of potential international oil supply problems, the oil price squeeze, and escalating prices for coal, foreign government energy policies and foreign utility companies placed increased emphasis on nuclear energy as an alternative to coal and petroleum for the generation of electricity. This was the situation among the industrialized foreign nations, particularly Western Europe and Japan, where forecasts of energy demand necessitated ambitious nuclear development programs. The developing nations were also formulating nuclear programs or placing greater emphasis on nuclear power. Tables 12 and 13 indicate the foreign nations having operable and planned nuclear powerplants. According to data compiled by the American Nuclear Society, 98 plants were operable in 18 countries, and 149 units were planned in 27 countries at yearend 1974. Most of those planned were scheduled for completion by 1985.

Despite these ambitious nuclear programs, deterrents were developing and were expected to influence future nuclear power programs. As in the United States, financing was problematical, and public attitude concerning environmental effects and reactor safety became a more significant issue. Special banks and investment companies were established for capital investment in nuclear power. It was also proposed that the oil-producing countries "recycle" their oil profits in nuclear development in Europe.

Available industrial capacity and manpower, reduced economic growth, and energy conservation practices also influenced planning for future primary and enriched uranium supplies. Western Europe and Japan continued to rely on enrichment services from the United States for the short term. The following tabulation indicates capacity and demand for enrichment services in Western Europe during 1975–85 (in SWU per year):[28]

	1975	1980	1985
Demand	3,500	10,000	23,000
Productive capacity	300	4,000	19,000

Table 12.—Operable foreign nuclear powerplants in 1974[1]

Country	Number of units	Capacity (megawatts electric)
Argentina	1	319
Belgium	2	1,260
Bulgaria	1	440
Canada	6	2,512
Czechoslovakia	1	110
France	10	2,888
Germany, East	2	515
Germany, West	8	3,393
India	3	600
Italy	3	547
Japan	8	3,753
Netherlands	2	532
Pakistan	1	125
Spain	3	1,073
Sweden	5	3,169
Switzerland	3	1,006
U.S.S.R.	10	3,309
United Kingdom	29	5,582
Total	98	31,133

[1] Construction completed, as of Dec. 31, 1974.

Source: American Nuclear Society.

Table 13.—Scheduled foreign nuclear powerplants[1]

Country	Number of units	Capacity (megawatts electric)
Argentina	1	600
Austria	1	692
Belgium	3	2,320
Brazil	1	626
Bulgaria	3	1,320
Canada	10	6,236
Czechoslovakia	4	1,760
Finland	4	2,160
France	20	18,478
Germany, East	3	1,320
Germany, West	15	14,878
Hungary	2	880
India	5	1,110
Iran	4	4,200
Italy	4	2,814
Japan	16	11,800
Korea, Republic of	3	1,764
Mexico	2	1,320
Philippines	2	1 252
Romania	1	440
Spain	8	7,262
Sweden	5	4,180
Switzerland	5	4,847
Taiwan	6	4,924
U.S.S.R.	10	7,000
United Kingdom	10	6,200
Yugoslavia	1	615
Total	149	110,998

[1] Under construction or ordered, as of Dec. 31, 1974.

Source: American Nuclear Society.

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[28] Nuclear News. Reports on Nuclear Programs Around the World. V. 18, No. 3, February 1975, pp. 39–44.

Demand in excess of production would be met primarily by enrichment services in the United States. The tripartite centrifuge enrichment project (United Kingdom, West Germany, Netherlands) proceeded toward development of enrichment facilities of 200,000 SWU each at Almelo, Netherlands and Capenhurst, United Kingdom. The organization had firm orders for 11 million SWU for future delivery and planned annual capacity of 2 million SWU by 1980. In October the first loading of gas centrifuge enriched fuel took place at a small reactor in the Netherlands. The uranium was enriched to 2.8% U_{235} at Almelo.

Construction on the multinational Eurodif gaseous diffusion enrichment project was advanced because of the improved European and world market for enriched uranium. In May a site was selected at Tricastin, France, where electric power will be supplied by four 900-to-1,000-Mw pressurized water reactors. The plant was scheduled for startup at 3.5 million SWU in 1979 and ultimate capacity of 9 million SWU in 1983. In addition to France, the principal participant, interests were held by Italy, Belgium, and Spain. Sweden terminated participation in March. Late in the year, Iran assumed participation through a joint French-Iranian company.

The European Economic Community (EEC) established a goal for nuclear power of 50% of total energy output in 1985. EEC nuclear capacity, 20,000 megawatts in 1974, was scheduled to increase tenfold to 200,000 Mw by 1985. Firm plans were established for 170,000 Mw by 1985.[29]

According to a survey conducted by the International Atomic Energy Agency (IAEA), the oil price rise made the economics of nuclear power more attractive among the developing nations. Before the quadrupling in oil prices, only nuclear power units exceeding 400 Mw were considered feasible in terms of demand, capital, and supporting facilities in the developing nations. Since the oil price rise, nuclear units as small as 100 Mw were considered feasible. Despite this economic advantage, only 8 of 50 developing nations surveyed by IAEA had nuclear powerplants operating or under consideration.

Table 14.—Uranium oxide (U_3O_8) concentrate: World production by country

(Short tons)

Country [1]	1972	1973	1974 [p]
Argentina	41	40	[e] 40
Canada	[r] 4,881	4,759	4,701
France	[2] 1,940	[2] 2,113	[e] 2,200
Gabon	577	712	852
Niger	[r] 958	1,046	1,232
Portugal [e]	105	105	105
South Africa, Republic of	4,000	3,411	3,389
Spain	[r] 165	134	49
Sweden [e]	80	80	80
United States	12,900	13,235	11,528
Total	[r] 25,647	25,635	24,176

[e] Estimate. [p] Preliminary. [r] Revised.

[1] In addition to the countries listed, Australia, Brazil, Czechoslovakia, Finland, East Germany, West Germany, Hungary, India, Japan, the People's Republic of China, and the U.S.S.R. are believed to have produced uranium oxide, but information is inadequate to make reliable estimates of output levels.

[2] Produced in part from imported material.

Australia.—Established uranium reserves continued to rise during 1974. Pancontinental Mining Ltd. (65%) and Getty Oil Development Co. (35%) reported a number of increases in reserve estimates as exploration continued at the Jabiluka 1 and 2 deposits, Northern Territory. At yearend, reserves at the Jabiluka were reported at 115,200 tons U_3O_8, making it Australia's largest uranium deposit. Estimates of Australia's measured and indicated uranium reserves, most of which are recoverable at costs of $10 per pound U_3O_8, were as follows, as of January 1, 1974:[30]

Location	Deposit	Reserves (tons U_3O_8)
Northern Territory	Ranger	110,600
Do	Jabiluka 1–2	115,200
Do	Nabarlek	11,600
Queensland	Mary Kathleen	11,000
Do	Mount Isa, Westmoreland	17,300
South Australia	Beverly	19,300
Western Australia	Yeelirree	50,800
Total		335,800

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[29] Chemical Week. Winds of Change Give Atom Energy Plants Big Push. V. 115, No. 9, Aug. 28, 1974, pp. 20–24.

[30] U.S. Embassy, Canberra, Australia. Uranium Reserves and Export Prospects. Enclosure 1 to State Department Airgram A-051, Apr. 3, 1974, 2 pp.

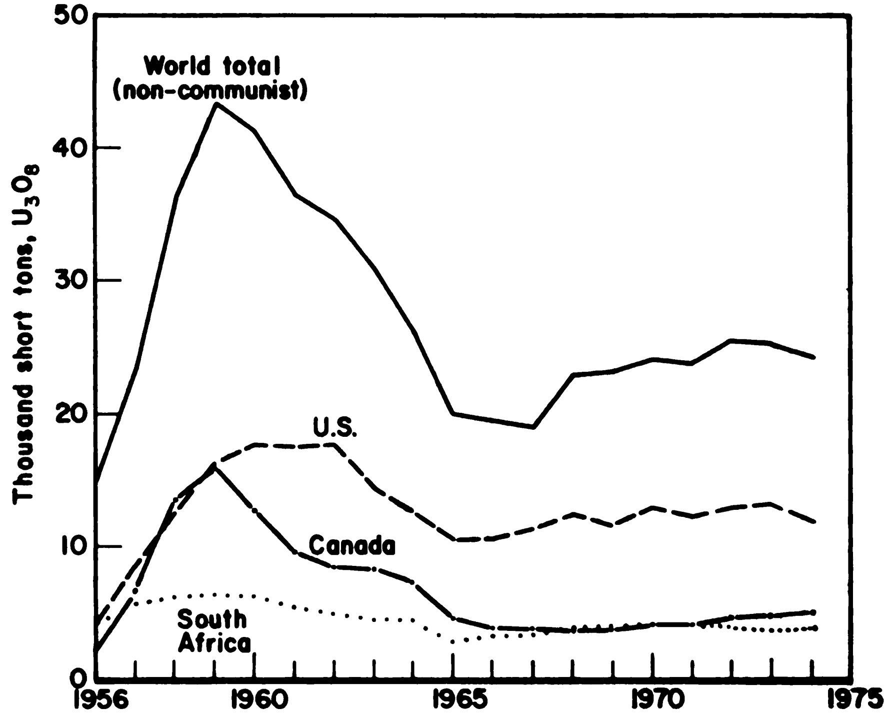

Figure 3.—World production of uranium concentrate (U_3O_8).

This does not include deposits in the Northern Territory and South Australia which have not been completely evaluated, particularly the Koongara deposit of Noranda Australia Inc., which is expected to be sizable.

In November the Prime Minister issued guidelines for Government control of and foreign participation in Australia's mineral industry, including uranium.[21] The uranium policy specified Government ownership of deposits and Government-industry partnerships in the Northern Territory; the Australian Atomic Energy Commission (AAEC), as the Government agent, would undertake all new exploration in the Northern Territory; a Government-sponsored mill in the Northern Territory; no new foreign participation; and AAEC-negotiated export contracts.

The Government planned to honor existing contracts for delivery of uranium. In August the Government agreed to underwrite a $30 million share issue by Mary Kathleen Uranium Ltd. for rehabilitating and reopening the Mary Kathleen mine in Queensland. Production was scheduled for 1976 at a rate of 1,000 tons U_3O_8 per year to fulfill contracts for approximately 5,200 tons U_3O_8. A total of 9,000 tons U_3O_8 will be delivered to Japan during 1976–86.

AAEC anticipated little demand for uranium in Australia before 1985, a cumulative demand of 30,000 tons U_3O_8 at the end of the century, and a total demand of 45,000 tons U_3O_8 to fuel planned reactors beyond 2000.[22]

Brazil.—Uranium reserves were small, but plans were made for an expanded exploration program. For 1974 $10 million was budgeted for exploration; for 1975 the budget will be doubled to $20 million. Reserves at a maximum of $15 per pound U_3O_8 were approximately 12,000 tons U_3O_8 at Cercado and Agostinho, near Poços de Caldas, State of Minas Gerais, and at Figueira, State of Paraná.[33] A pilot mill was in operation near the Cercado and Agostinho deposits late in the year.

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[21] U.S. Embassy, Canberra, Australia. Prime Minister's Guidelines on Foreign Investment in Mining. Enclosure 1 to State Department Airgram A-212, Nov. 15, 1974, 1 p.

[22] Australian Atomic Energy Commission. Twenty-second Annual Report, 1973–74. Canberra, Australia, Aug. 23, 1974, 115 pp.

The Comissão Nacional de Energia Nuclear (CNEN) and its subsidiary for technology, Cia. Brasileira de Technologia Nuclear (CBTN), announced a large investment in nuclear research and development, uranium enrichment, and commercial reactor construction. A research and development budget totaling $570 million was proposed for 1975–80. CNEN planned for eight 1,200-megawatt reactors by 1990.

Canada.—Uranium production was slightly lower than that of 1973, owing chiefly to a production loss by Denison Mines, Ltd. at its Elliot Lake mine, Ontario. This loss was attributed to labor problems and the mining of lower grade ores.[34] Production continued at three operations—Rio Algom Mines Ltd., at Elliot Lake, and Eldorado Nuclear Ltd., in northern Saskatchewan, in addition to the Denison operation.

There were indications of renewed interest in uranium exploration following several years of little activity and a near standstill in 1973. This trend toward increased exploration was spurred by rising uranium prices and a developing seller's market. In addition to the provinces of Ontario and Saskatchewan, where activity was more extensive, prospecting and exploration for uranium were underway in virtually all other provinces.

In view of increasing foreign interest in purchasing Canadian uranium, the three operating mines and mills were undergoing expansion, and new operations were planned or under development. At Elliot Lake, Ontario, Denison Mines was increasing mine capacity by modifying its hoisting system and developing new ore. Mine capacity was being expanded to 10,000 tons of ore per day, and mill capacity to 7,100 tons per day. The nearby Stanrock mine, acquired through a merger, may be reopened and provide underground access to adjacent Denison properties.

Rio Algom Mines Ltd. operated its Quirke mill near full capacity of 4,500 tons per day. Mine expansion to 14,000 tons of ore per day and corresponding mill expansion (7,000 tons per day at the Quirke mill and 7,000 tons per day at the Nordic mill, which will be reactivated) were scheduled for 1980.

At Rabbit Lake, northern Saskatchewan, Gulf Minerals Canada Ltd. was stripping overburden for its open pit mine, and a 2,000-ton-per-day mill was near completion at yearend. Mining was scheduled for early 1975.

The Eldorado Nuclear Ltd. mill, also in northern Saskatchewan, was worked at only about 50% of capacity during 1974. Production was lower because one ore body was mined out. However, planned expansion will include new development, mine rehabilitation, and mill modernization.

Other prospective new operations included that of Agnew Lake Mines, Ltd. at Agnew Lake, Ontario, where a 2-year pilot plant, insitu leach project was planned for broken ores in stopes, and the Amok Ltd. Cluff Lake mine, northern Saskatchewan, which may be in operation by 1977.

A review of plans indicated that annual output of approximately 24 million pounds U_3O_8 may be anticipated before 1980.[35] It would be distributed as follows:

Company	Mine-mill location	Annual capacity (million pounds U_3O_8)
Rio Algom Mines Ltd.	Elliot Lake, Ontario	8.0
Denison Mines, Ltd.	do	6.0
Gulf Minerals Canada Ltd.	Rabbit Lake, Saskatchewan	4.5
Eldorado Nuclear Ltd.	Uranium City, Saskatchewan	2.5
Amok Ltd	Cluff Lake, Saskatchewan	2.0
Agnew Lake Mines, Ltd.	Agnew Lake, Saskatchewan	1.0
Total		24.0

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[33] Engineering and Mining Journal. Brazil Launches Long-Range Program for Nuclear Development. V. 175, No. 12, December 1974, pp. 34, 39.

[34] Williams, R. M. Uranium: Shortage Hikes Prices. Can. Min. J., v. 69, No. 2, February 1975, pp. 130–135

[35] Nucleonics Week. V. 15, No. 24, June 13, 1974, p. 3.

The Government announced a new uranium export policy.[36] Effective September 5, 1974, it would provide for uranium sufficiency for domestic nuclear powerplants; a reappraisal of uranium resources up to a price of $30 per pound U_3O_8 by the Department of Energy, Mines, and Resources; export of uranium in the most advanced form, which is now UF_6 but may include enriched uranium and nuclear fuels in the future; a maximum contract period of 10 years, with possible 5-year extension; and a purchaser agreement not to reexport uranium acquired in Canada.

Annual uranium demand in Canada was about 550 tons U_3O_8 in 1974 and was expected to be 1,500 tons U_3O_8 in 1980. Committed nuclear capacity was 14,770 megawatts in 1974. Additional CANDU-type plants were planned at Pickering, Bruce, and Bowmanville in Ontario and at the Gentilly complex in Quebec. It was anticipated that by the year 2,000, 100,000 megawatts nuclear would be installed in Canada, and cumulative demand would be 150,000 tons U_3O_8.[37]

France.—During 1974 an ambitious nuclear power development program was announced as a means of reducing dependence on imported oil. Electricité de France (EdF), the national utility company, placed the largest nuclear reactor order to date—for twelve 900- to 1,000 Mw PWRs. The order was placed with Société Franco-Americain de Conservation Atomiques (Framatome), in which Westinghouse Electric Corp. is the reactor licensor and holds a 45% interest. EdF planned 50,000 Mw of nuclear capacity on line by 1985. The announced schedule called for the ordering of 6 units in 1974, 7 units in 1975, and 7 units per year from 1976 to 1980.[38]

Although Eurodif, the multinational uranium enrichment project, was advanced during 1974 with commitments to foreign participation and selection of a site in France, rising demand for enrichment services may necessitate purchases from the U.S.S.R., the extension of existing contracts with the United States, and purchases from the tripartite centrifuge enrichment project of the United Kingdom, the Netherlands, and West Germany.

France's prototype fast breeder, the 250-Mw Phénix, became the largest fast breeder operating at full nominal capacity. The next stage in fast breeder development is the 1,200-Mw Super Phénix, construction of which will be started in 1975. It will be owned by a multinational organization comprising French, Italian, and West German interests.

Germany, West.—In August the small uranium mill at Ellweiler resumed production after being idle for 1 year. A new mining license was granted to Gewerkschaft Brunhilde for the mining of 20,000 tons of ore by yearend 1974.

There were eight operable nuclear powerplants, and seven were under construction. The official Government plan called for 20,000 Mw nuclear capacity by 1980 and 45,000 to 50,000 Mw by 1985. Research and development continued on the second generation high-temperature gas-cooled (HTGR) and the fast breeder reactor at Kalkar.

Italy.—Production capacity of the mine at Novazzo, near Brescia, which is owned and operated by AGIP Mineraria, was 120 tons U_3O_8 per year. Reserves were 1,500 tons U_3O_8. A discovery in the Lazio area, near Viterbo, 50 miles north of Rome, reportedly contained 11,000 tons U_3O_8.

Japan.—Tokyo Uranium Development Corp., comprising five companies, was formed to promote the development of uranium deposits in Africa, Canada, Australia, and South America.

Japan will continue to rely on the United States for short-term enrichment services but was attempting to diversify its sources for these services. Early in the year, Japan agreed to purchase 1 to 1.5 million SWU per year during 1980–90 from the French-sponsored Eurodif project at a reported price of $57 per SWU. The U.S.S.R. may also provide enrichment services.

The Enrichment and Reprocessing Preparatory Group, comprising the Japan Atomic Power Co. and nine utility companies, will consider a large multinational project for uranium enrichment. The Government-controlled Power Reactor and Nuclear Fuel Development Corp. operated the first cascade under its gas centrifuge development program. A pilot plant was scheduled for 1978 and a commercial plant for 1 million SWU per year by 1985.

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[36] U.S. Embassy, Ottawa, Canada. Canadian Uranium Policy. Enclosures 1–4 to State Department Airgram A-456, Sept. 10, 1974, 67 pp.

[37] Gilchrist, W. M. Future Uranium Needs a Challenge to Canada's Mining Industry. The Northern Miner, v. 59, No. 51, Mar. 7, 1974, pp. 37, 62.

[38] Nuclear Industry. Framatome in Line for Order of 12 PWRs for Early Construction. V. 21, No. 3, March 1974, p. 41.

Seven power reactors were in operation, and 15 were scheduled for completion during 1974–78. A new project, termed "the world's largest nuclear power center," would eventually reach 20,000 Mw in 20 plants along the north Pacific coast of Japan. Geological, climatic, and biological studies were underway on the environmental feasibility of a project of this magnitude.

Niger.—New exploration agreements were concluded. Continental Oil Co. and the French Commisariat'á l'Energie Atomique (CEA) started 3-year exploration venture on a CEA concession 50 miles south of the producing mine and mill at Arlit. Société des Mines du Djado was formed by CEA, the Government of Niger, and Urangesellschaft A.G. of West Germany to explore for uranium in the Djado region of northern Niger. In August, Japan's Power Reactor and Nuclear Fuel Development Corp. took a 25% interest in this venture.

Japan's Overseas Uranium Resources Development Co. joined with CEA and the Niger Government in Compagnie Miniére d'Akouta (COMINAK) in a mining and milling project west of Arlit. The mine will annually produce 650,000 tons of ore, which will be milled to about 2,400 tons U_3O_8.

South Africa, Republic of.—Uranium output, as a byproduct and coproduct at eight gold mines, was slightly lower than that of 1973. Production, in 1974, by mine, was as follows:

Mine	Pounds U_3O_8
Blyvooruitzicht	391,044
Buffelsfontein	1,609,857
Harmony	927,274
Hartebeestfontein	899,062
Vaal Reefs	1,954,279
West Driefontein	407,868
Western Deep Levels	300,375
West Rand Consolidated	288,164
Total	6,777,923

Thirteen gold mines were considered capable of supporting uranium production, and 11 mines had uranium extraction plants.

The South African Government held 20,000 tons U_3O_8 in stocks accumulated in excess of export sales contracts.

Because of anticipated growth in future demand for uranium, the Department of Mines started a comprehensive program evaluating uranium resources.

The enrichment pilot plant of the Government-owned Uranium Enrichment Corp. South Africa Ltd. (UEC) at Valindaba, near Pretoria, was near completion and was expected to be in operation in early 1975. UEC planned to proceed with construction of a large-scale commercial enrichment plant. Planning was in an advanced stage. Annual capacity of the plant will be 2.4 million SWU (2,645 tons of enriched uranium).[39]

In September plans were announced for a 2-unit reactor installation, each unit of 800- to 1,000-Mw capacity, at Koeberg, near Cape Town. A nuclear power program was proposed in order to preserve coal resources for the petrochemical industry for coal gasification and liquefaction.

South-West Africa, Territory of.—Open pit development and mill construction continued at the Rossing deposit. RTZ Corp. held the majority interest in Rossing Holding Co., the operating company. Rio Algom Mines Ltd. reportedly exercised an equity option for a 10% interest. The initial production rate will be 60,000 tons of ore per day and 15 million pounds U_3O_8 per year, making the mine the world's largest producer of uranium. The planned full production rate is 120,000 tons per day. Initial production was scheduled for late 1976 or early 1977.[40]

Sweden.—The Swedish Geological Survey was intensifying its search for uranium deposits. The Parliament approved an increase in the appropriation for uranium exploration to $2.2 million in fiscal 1975.

The low-grade Billingen shale in south-central Sweden, which is one of the world's largest uranium deposits in terms of U_3O_8 in ore, contains 0.03% U_3O_8 and 15% extractable hydrocarbons. The pilot mill at Ranstad (130 tons U_3O_8 per year), which remained inactive during 1974, may be enlarged to 1,300 tons U_3O_8 per year. This would necessitate the mining of 6 million tons of the shale per year.

United Kingdom.—After a year of uncertainty, a "White Paper on Nuclear Reactor Policy," released in July, announced a Government decision to proceed with nuclear power development based on the steam generating heavy water reactor (SGHWR) of U.K. design rather than the light water reactor of U.S. design.[41]

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[39] American Metal Market. Uranium Need To Exceed Capacity. V. 81, No. 138, July 17, 1974, p. 8.

[40] Mining Journal. South-West Africa—New Political Pressure. V. 283, No. 7261, Oct. 18, 1974, p. 336.

Fuel was loaded in the 250-Mw Dounreay fast breeder in March, and testing was underway late in the year. This prototype will be the basis for the design of a commercial-scale, 1,300-Mw fast breeder reactor.

TECHNOLOGY

ERDA-sponsored projects on new exploration techniques included the development of small-diameter, pulsed neutron generators and probes for the direct measuring of uranium in boreholes and portable equipment for detecting and measuring radon and radon daughter products in water and soil gas. Model boreholes were prepared for the development and calibration of special probes measuring low-intensity gamma radiation. Research on remote sensing techniques was expected to enhance the Earth Resources Technology Satellite digital data for detecting significant geological features, such as rock types and rock alteration, related to uranium deposits.[42]

Other exploration techniques under investigation included measurement of thermal gradient to determine relative heat flux between sample points in shallow boreholes. A heat anomaly would indicate the possible presence of uranium ores.[43] Samples of helium or other inert gases, collected from soil in shallow boreholes, 3 to 10 feet deep, may be analyzed for abnormal concentrations, which may be indicative of hydrocarbons or radioactive ores. Samples were collected in a newly developed canister, having an open bottom and a closed top, in which the gas sample replaces air.[44]

Data-processing techniques were applied in interpreting radon sample data from boreholes in an exploration area.[45] Moving averages and other statistical analysis permitted more consistent repeatable results.

A conceptual model was evolved for the major productive uranium districts and belts, giving exploration and geological criteria that may be useful guides to new uranium districts. In developing the model, geological similarities and variations were considered in the sandstone-type deposits.[46]

Rising demand and high uranium prices spurred investigations on the extraction and processing of low-grade and refractory ores. Renewed interest in insitu leaching, or solution mining, of uranium resulted in a number of new operational techniques. Hydraulic fracturing occurs when a fluid is pumped into an entry well until the pressure exceeds the resistance in the formation. Tensile fracturing is extended with continued pumping. Optimum physical conditions for uranium leach are based on knowledge of the fracture types and their orientation; the fluid pressure including shut-in pressure (when pumps are not working); geology of the area; and the mechanical, physical, and chemical properties of the formation, mainly porosity and permeability. Fracturing properties would determine the path of fluid flow and the well location and spacing.[47]

Blasting may also be used to prepare a uranium ore body for a leaching operation. Fracturing with equal displacement and uniform fragmentation is desirable. Downhole and tunnel blasting have been tested; the more suitable method would depend upon the properties of the ore body. The Bureau of Mines was working on a fragmentation technique. Initial research was on a porphyry copper deposit, but many factors would also be applicable to other mineral deposits, including uranium.

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[41] Atomic Industrial Forum. Britain's Long Debate Ends in Rejection of LWR for SGHWR. Nuclear Ind., v. 21, No. 7. July 1974, pp. 11–13.

American Nuclear Society. Reactor Decision Goes to SGHWR. Nuclear News, v. 17, No. 10, August 1974, p. 60.

[42] Energy Research and Development Administration. 1974 Annual Report to Congress. Jan. 17, 1975, pp. 131–132.

[43] Hardison, J. W. (assigned to Atlantic Richfield Co.). System of Prospecting for Underground Uranium Ore Bodies. U.S. Pat. 3,714,832, Apr. 1, 1974, 6 pp.

[44] Pogorski, L. A. Method and Device for Exploring for Hydrocarbons or Ores of Uranium and Thorium. U.S. Pat. 3,835,710, Sept. 17, 1974, 21 pp.

———. Geochemical Exploration for Subsurface or Underwater Deposits of Hydrocarbons or Ores of Uranium and Thorium. U.S. Pat. 3,862,576, Jan. 28, 1975, 9 pp.

[45] Soonawala, N. M. Data Processing Techniques for the Radon Method of Exploration. Can. Min. and Met. Bull., v. 67, No. 744, April 1974, pp. 110–116.

[46] Fischer, R. P. Exploration Guides to New Uranium Districts and Belts. Econ. Geol., v. 69, No. 3, 1974, pp. 362–376.

[47] Engineering and Mining Journal. Solution Mining Opening New Reserves. V. 175, No. 7, July 1974, pp. 62–71.

Other leaching techniques under investigation included the addition of soluble aluminum sulfate, which limits the reduction in permeability of the deposit, thereby improving leach efficiency, and contacting the leach solution at depth with oxygen under pressure. The latter would convert the tetravalent uranium ion to the more readily soluble hexavalent ion.[48]

Several methods were employed to improve efficiency in heap, vat, or batch leaching operations. The ore may be agitated and dried to increase permeability or may be suspended in the leach solution and then treated with sodium chlorate and a polymer to. inhibit settling. Countercurrent leaching also may be useful, the leachant circulating upward through the ore descending from a feed inlet.

The Bureau of Mines initiated a project testing insitu leaching methods and costs. This project included a computer simulation program and the development of mathematical models for a pilot plant operation. A cooperative agreement was concluded with industry for a test site in the Red Desert, Wyo.

A borehole hydraulic mining method was developed for use in small, low-grade uranium deposits.[49] A capsule with a high-pressure water sinking jet, a flushing jet, and a hydraulically driven positive displacement pump is lowered into a service hole drilled 6 feet below the mining zone. The jet is rotated during operations. A mining rate of 40 tons of ore per hour was achieved with a jet pressure of 500 to 700 pounds per square inch.

Improved calibration procedures have been developed with new equipment for measuring and interpreting radon and its daughter products in underground uranium mines.[50]

A newly designed slide rule was developed for fast and accurate radon-daughter computations.[51] This instrument replaces tables, nomographs, and manual methods and minimizes the chance for mechanical or mathematical errors.

Numerous materials, including polyesters, resins, epoxies, lattices, and inorganic coatings, were tested in Bureau of Mines laboratories as sealants against radon gas in uranium mine walls. These materials could seal off up to 100% of the radon and were designed to be used in the main mine workings carrying fresh air to working areas. Field tests were planned.[52] For more efficient radon control, mine vent design and ore handling methods should receive increased attention during mine planning and development.[53] Methods to reduce radon contamination were described.

In Japan plans were made to use the heat from nuclear powerplant discharge water for recovery of uranium from seawater.[54] A newly developed absorber was a composite of active carbon and metallic bases of titanium and zinc. Two pilot plants will be built at coastal sites. It was estimated that uranium would be recoverable at a cost of $50 to $60 per pound U_3O_8.

The Bureau of Mines expanded its research and development work on processing technology for recovery of uranium from low-grade and refractory ores. Carboniferous ores resistant to conventional acid leach, were subjected to preliminary roast and flotation concentration to improve leachability. Low-grade resources under study included the Chattanooga shale, reduced to minus 3-mesh and subjected to stage leaching, samples from Wyoming and California containing 0.02% to 0.04% U_3O_8, and a flyash sample from a coal-fired powerplant, assaying 0.001% to 0.003% U_3O_8.

A strong (6*N*) sulfuric acid leach provided uranium recovery from refractory ore on a laboratory scale.[55] Strong acid leaching minimizes crushing and grinding costs, provides less effluent, provides savings in acid and water consumption, and requires only 20% to 25% of the leaching time for conventional processing.

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[48] Learmont, R. P. (assigned to United States Steel Corp.). In-Situ Leaching Extraction of Uranium Values From an Underground Uranium Ore Deposit. U.S. Pat. 3,866,289, Jan. 14, 1975, 4 pp.

Pace, G. F., and E. W. Shortridge (assigned to Continental Oil Co.). Static Bed Leaching of Uranium Ore. U.S. Pat. 3,801,694, Apr. 2, 1974, 10 pp.

[49] Engineering and Mining Journal. V. 176, No. 3, March 1975, p. 9.

[50] Beckman, R. T. Calibration Procedures for Radon and Radon-Daughter Measurement Equipment. MESA Inf. Rept. 1005, 1975, 47 pp.

[51] Beckman, R. T., and R. L. Rock. Radon-Daughter Slide Rule. MESA Inf. Rept. 1003, 1974, 11 pp.

[52] Franklin, J. C., L. T. Nuzum, and A. L. Hill. Polymeric Materials for Sealing Radon Gas Into the Walls of Uranium Mines. BuMines RI 8036, 1975, 26 pp.

[53] Rock, R. L. Mine Engineering and Ventilation Problems Unique to the Control of Radon Daughters. MESA Inf. Rept. 1001, 1974, 11 pp.

[54] American Nuclear Society. Fuel From the Sea Sought by 1985. Nuclear News, v. 17, No. 15, December 1974, p. 72.

[55] Chemical Engineering. Uranium Processing Update. V. 82, No. 5, Mar. 3, 1975, pp. 88–89.

Engineering and Mining Journal. British Strong-Acid Leach Process Targeted at Refractory Uranium Ores. V. 176, No. 5, May 1975, p. 105.

The precipitation of uranium by hydrogen peroxide provided a better quality concentrate than that from precipitation with ammonia. Variable tests were made with hydrogen peroxide precipitant; initial and reaction pH, temperature and time, and content of vanadium, molybdenum, and sulfate, which are common yellowcake impurities.[56]

Solar heat will be employed to heat mill water to 140° F at a uranium mine and mill under development in New Mexico. The water will be heated in solar ponds, 2 inches deep and covering 6 acres. The ponds will have black bottoms for heat absorption and plastic covers.[57]

An electrolytic reduction process for refining and conversion to UF_4 at the mine site, bypassing the intermediate yellowcake stage, was reported in Japan.[58] The process involves high-efficiency cation exchange membranes and platinum-plated electrodes in an aqueous solution at room temperatures. The ore is leached in a UO_2SO_4 solution, which goes to mixer-settlers where an amine (in kerosine) extracts uranium as a sulfate complex. This is converted to uranyl chloride, which is reduced electrolytically to uranous chloride. A reaction with hydrofluoric acid forms UF_4.

Progress was reported in isotopic enrichment of U_{235} by the laser beam in the laboratory.[59] In one of a number of laser-related approaches to enrichment, the isotopic separation depends on the spectroscopic structures of molecules. In ERDA-sponsored research, a stream of hot atomic uranium gas was passed through a carefully tuned laser beam and intense ultraviolet light of an arc lamp. The laser selectively excited the electrons of the U_{235} isotope to an energy level enabling the ultraviolet light to ionize the atoms. The U_{235} isotopes acquired a net plus charge and were attracted to a negative charge collector. A high level of enrichment appeared attainable from a single pass through the laser device. Therefore, fewer enrichment stages would be needed and capital costs and power consumption would be substantially lower than from gaseous diffusion or gas centrifuge enrichment. However, for a commercial operation it would be necessary to scale up the laser energy one thousandfold.

Second generation gas-centrifuge models for isotopic enrichment were under reliability testing by ERDA. First generation models had undergone testing for 2 years. Advanced third generation models were through the initial design stage, and prototypes were undergoing testing.[60]

Another enrichment technique, the jet nozzle, was advanced by research in West Germany. A gas stream of 5 mole-percent UF_6 and 95 mole-percent helium or hydrogen was compressed through nozzles and directed toward a curved deflection wall, the heavier U_{238} isotopes following the outer paths. Energy consumption was high in this method.[61]

ERDA continued its basic research and development program on four breeder concepts—the liquid metal, fast breeder reactor (LMFBR), the light water breeder, the gas-cooled breeder, and the molten salt breeder. Reference designs, work schedules, and cost data were established for the demonstration Clinch River LMFBR in Tennessee. The Fast Flux Test Facility for testing breeder fuels and materials, and for safety and reactor development experience, was 40% completed at yearend. Progress was made in studies on advanced oxide fuels and higher breeding mixed uranium-plutonium carbide and nitride fuels.

Increased attention was given worldwide to the industrial use of reactor process heat.[62] In Japan research and design work on utilization of process heat were conducted on large, very high temperature, gas-cooled reactors. In West Germany, the emphasis was on process heat for coal gasification and liquefaction and the separation of hydrogen and oxygen from water. Steelmaking with reactor process heat, which would employ hot reducing gas in a direct-reduction process, combines the high temperature gas-cooled reactor, a catalytic steam reformer for converting fuel into a suitable reducing gas, a direct-reduction furnace for sponge iron, and an electric arc furnace. A technical obstacle was radiation safety in the heat exchanging mechanism.

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[56] Shabbir, M., and K. E. Tame. Hydrogen Peroxide Precipitation of Uranium. BuMines RI 7931, 1974, 13 pp.

[57] Chemical Week. Solar Energy Will Provide Low-Cost Hot Water for Uranium Milling. V. 115, No. 15, Oct. 9, 1974, p. 63.

[58] Chemical Engineering. Uranium Refined by Electrolytic Reduction Gets Boost in Japan. V. 81, No. 25, Nov. 25, 1974, pp. 34–35.

[59] American Nuclear Society. Uranium Enrichment Shown Scientifically Feasible. Nuclear News, v. 17, No. 10, August 1974, p. 84.

Metz, W. D. Uranium Enrichment: Laser Methods Nearing Full-Scale Test. Sci., v. 185, No. 4151, Aug. 16, 1974, pp. 602–603.

[60] American Nuclear Society. United States Has Technology for Centrifuge Plant. Nuclear News, v. 17, No. 5, April 1974, pp. 60, 64.

[61] Chemical Engineering. Nozzle Separation May Go Commercial Soon, Laser Enrichment Is Further Off. V. 82, No. 6, Mar. 17, 1975, p. 25.

[62] The Atom. Nuclear Heat for Industry—A Coming Revolution? V. 11, No. 6, November-December 1974, pp. 16–18.

In radioactive waste management, a new process, called the VR–20, was developed for treating low-level wastes.[63] Air is the fluidizing medium in this fluidized-bed calcination process. Water and air were driven off, leaving the solids in granular particles, which were formed into a solid mass by adding a thermosetting resin. The waste product for transportation would be homogeneous, water-free, and virtually unleachable.

Another proposal was made for disposal of high-level radioactive wastes in geological formations. This would be beneath mesas and plateaus in the arid and semiarid western and southwestern United States. The wastes, fused to glass of low solubility, would be placed in sealed containers, which would be stored in boreholes 50 to 100 feet below the surface.[64]

ERDA was studying three engineering concepts for retrievable surface storage—in water, in air-cooled vaults, and in surface casks. A pilot plant for testing disposal in geological formations was planned. Concerning transport of radioactive waste materials, package performance tests were made on the definition and evaluation of stresses that may result from accidents during air, rail, and highway transport. Casks as large as 25 tons will be tested.[65]

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[63] American Nuclear Society. Strong Claims for New System; Impact Awaited. Nuclear News, v. 17, No. 14, November 1974, p. 82.

[64] U.S. Geological Survey. Desert Sites Suggested for Radioactive Wastes "Graveyard." Department of the Interior News Release, Oct. 6, 1974, 3 pp.

[65] Pages 155–160 of work cited in footnote 42.

Vanadium

By Grace N. Broderick [1]

Consumption of vanadium in the United States continued to increase, reaching an alltime high of 7,200 short tons in 1974. The vanadium ore of Arkansas remained, as in 1973, the principal domestic source of supply. For the first time since 1968, domestic production of vanadium pentoxide increased. Exports of both ferrovanadium and vanadium ores, concentrates, and oxides declined in 1974. Imports of ferrovanadium and of residues and slags also were down from those of the previous year. U.S. price quotations for the principal vanadium materials, which remained stable in 1973, rose appreciably in 1974.

Table 1.—Salient vanadium statistics
(Short tons of contained vanadium)

	1970	1971	1972	1973	1974
United States:					
Production:					
Ore and concentrate:					
Recoverable vanadium [1]	5,319	5,252	4,887	4,377	4,870
Value ---- thousands	$34,923	$37,690	$30,867	$26,611	$38,266
Vanadium pentoxide recovered	5,594	5,293	5,248	4,864	5,368
Consumption	5,134	4,802	5,227	6,393	7,200
Exports:					
Ferrovanadium and other vanadium alloying materials (gross weight)	2,155	676	269	1,416	1,335
Vanadium ores, concentrates, oxides, vanadates	973	260	176	232	203
Imports (General):					
Ferrovanadium (gross weight)	21	89	578	303	225
Ores, slags, residues	2,000	2,350	1,400	2,600	2,170
World production	r 19,939	r 20,502	r 20,239	r 21,633	22,149

r Revised.

[1] Recoverable vanadium contained in uranium and vanadium ores and concentrates received at mills, plus vanadium recovered from ferrophosphorus derived from domestic phosphate rock.

Legislation and Government Programs.—There were no sales of vanadium in 1974 from the U.S. Government stockpile. The physical inventory, as of December 31, 1974, totaled 639 tons of vanadium, all of which was in the national stockpile. Of this total, 55 tons was contained in ferrovanadium, and 584 tons was contained in vanadium pentoxide. The ferrovanadium and 44 tons of the pentoxide had been sold previously and were awaiting shipment out of the Government stockpile. This left an uncommitted inventory of 540 tons of vanadium pentoxide, which cannot be sold until Congressional authorization is obtained.

DOMESTIC PRODUCTION

The principal domestic source of vanadium in 1974 continued to be the vanadium ore of Arkansas. The amount of vanadium recovered from Colorado Plateau uranium-vanadium ores increased, but that from Idaho ferrophosphorous declined. Some mills also processed vanadium-bearing oil residues, spent catalysts, and foreign vanadium-containing slags. Vanadium obtained by processing imported vanadium-containing slags was not included in any of the production figures shown in the tables nor was the vanadium recovered directly from slags or residues as ferrovanadium or similar products.

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[1] Physical scientist, Division of Ferrous Metals.

Union Carbide Corp. continued to operate both its Uravan-Rifle mill complex in Colorado, and its Hot Springs, Ark., mill, while Kerr-McKee Corp. continued to recover vanadium from ferrophosphorous at Soda Springs, Idaho. Susquehanna-Western, Inc., sold its ore milling and processing facility at Edgemont, S. Dak., to the Tennessee Valley Authority (TVA) in August, and the plant was shut down. TVA planned to refurbish and enlarge the milling facilities, but actual commitment to final plans would depend upon completion and approval of an environmental impact statement.

Atlas Corp. proceeded with installation of a vanadium recovery circuit at its Moab, Utah, mill. The company continued to develop and mine some of the uranium-vanadium ore discovered in 1972.

Under the management of its Minerals & Chemicals Div., Engelhard Minerals & Chemicals Corp. began production of ferrovanadium in January 1974 at its new Strasburg, Va., plant, which has an annual capacity of about 1,000 tons of contained vanadium. Philipp Brothers, another division of Engelhard Minerals & Chemicals Corp., was responsible for the feed material and sales of the production.

Geo Industries, Inc., started shipping uranium-vanadium ore from its Geo No. 1 mine at Wray Mesa, Colo., to the Uravan mill of Union Carbide Corp.

Table 2.—Mine production and recoverable vanadium of domestic origin produced in the United States

(Short tons of contained vanadium)

Year	Mine production [1]	Recoverable vanadium [2]
1970	5,793	5,319
1971	5,547	5,252
1972	4,699	4,887
1973	4,117	4,377
1974	5,240	4,870

[1] Measured by receipts of uranium and vanadium ores and concentrates at mills, vanadium content.

[2] Recoverable vanadium contained in uranium and vanadium ores and concentrates received at mills, plus vanadium recovered from ferrophosphorus derived from domestic phosphate rock.

Table 3.—Production of vanadium pentoxide in the United States [1]

(Short tons)

Year	Gross weight	V_2O_5 content
1970	11,035	9,986
1971	10,492	9,448
1972	10,410	9,367
1973 [2]	8,226	8,683
1974 [2]	9,304	9,583

[1] Includes vanadium pentoxide and metavanadate produced directly from all domestic sources, plus small byproduct quantities from imported chromium ores in 1971 and the preceding years.

[2] V_2O_5 content exceeds gross weight because it includes considerable V_2O_4.

CONSUMPTION AND USES

Domestic consumption of vanadium, reported by type of material in table 4 and by end use category in table 5, rose about 13% in 1974 to reach an alltime high of 7,200 short tons. Increases occurred in all end-use categories except electric steel, tool steel, cast irons, cutting and wear resistant materials, welding and alloy hard-facing rods and materials, and pigments. Only in November did consumption drop below the rate of 500 or more tons per month. Eighty-seven percent of the vanadium was consumed as ferrovanadium and associated proprietary vanadium-iron-carbon materials. This represents the third consecutive year of increased consumption for these alloying elements.

The Vanadium International Technical Committee (Vanitec), formed in 1973 to promote greater use of vanadium, has progressed well. Its main efforts were directed in 1974 towards the development of line pipe steels for oil and gas transmission lines.

Table 4.—Consumption and consumer stocks of vanadium materials in the United States
(Short tons of contained vanadium)

Type of material	1973 Consumption	1973 Ending stocks	1974 Consumption	1974 Ending stocks
Ferrovanadium[1]	5,600	1,135	6,076	1,732
Oxide	199	49	218	83
Ammonium metavanadate	45	9	41	6
Other[2]	549	98	865	163
Total	6,393	1,291	7,200	1,984

[1] Includes other vanadium-iron-carbon alloys.

[2] Consists principally of vanadium-aluminum alloy, plus relatively small quantities of other vanadium alloys and vanadium metal.

Table 5.—Consumption of vanadium in the United States, by end use
(Short tons of contained vanadium)

End use	1974
Steel:	
Carbon	900
Stainless and heat resisting	38
Full alloy	1,744
High-strength, low-alloy	2,398
Electric	W
Tool	936
Cast irons	52
Superalloys	55
Alloys (excluding steels and superalloys):	
Cutting and wear resistant materials	W
Welding and alloy hard-facing rods and materials	10
Nonferrous alloys	722
Other alloys[1]	W
Chemical and ceramic uses:	
Catalysts	255
Other[2]	W
Miscellaneous and unspecified	90
Total	7,200

W Withheld to avoid disclosing individual company confidential data, included in "Miscellaneous and unspecified."

[1] Includes magnetic alloys.

[2] Includes pigments.

STOCKS

In addition to the consumers' stocks shown in table 4, producers' stocks of vanadium as fused oxide, precipitated oxide, metavanadate, metal, alloys, and chemicals totaled 1,920 short tons of contained vanadium at yearend 1974, compared with 2,815 short tons at yearend 1973.

PRICES

Prices in the United States for the principal vanadium materials, which were stable throughout 1973, moved upward during 1974 following the decontrol of ferroalloy prices in March.

The price for domestic 98% fused vanadium pentoxide, as quoted by Metals Week, which had remained at $1.50 per pound of contained V_2O_5 in 1973, increased to $1.75 effective March 1 and to $1.90 effective July 1. As of August 1, this became a dual quote of $1.90 to $2.72 per pound of contained V_2O_5. Effective October 1, Kerr-McGee Corp. raised its price 25 cents to $2.15 per pound of contained V_2O_5 and later raised it as of December 1 to $2.45. Union Carbide Corp. increased its price from $2.72 to $3.06 effective November 1.

The price for technical-grade, air-dried vanadium pentoxide, which at the beginning of the year was $2.21 per pound of contained V_2O_5, f.o.b. plant, was increased to $2.41 effective June 1 and to $2.72 effective August 1. As of November 1, the price quotation was $2.98-$3.06.

A price quotation for dealer-export merchant technical-grade vanadium pentoxide, which had been $1.50 per pound of contained V_2O_5 since July 1971, was no longer published by Metals Week after January 1974.

The price for U.S. standard grade ferrovanadium, which began the year at $4.19 per pound of contained vanadium, f.o.b. shipping plant, was increased to $4.62 effective June 1, to $5.21 effective August 1, and to $6.35 effective November 1. Foote Mineral Co., effective May 1, raised the price of its Ferovan to $3.96 per pound of contained vanadium, effective July 1 to $4.50, and effective November 1 to $5.10. Union Carbide Corp., effective June 1, raised the price of Carvan to $3.99 per pound of contained vanadium, effective July 1 to $4.50, and effective November 1 to $5.10. Carvan began the year at $3.66 per pound of contained vanadium and Ferovan at $3.68 per pound of contained vanadium.

FOREIGN TRADE

Exports of both ferrovanadium and vanadium ores, concentrates, and oxides were down from the previous year. The decreases in ferrovanadium and vanadium exports were about 6% and 13%, respectively. The average declared value for exports of ores, concentrates, and technical-grade oxides was $1.83 per pound of contained vanadium pentoxide in 1974, compared with $1.40 per pound in 1973. The average declared value for exports of ferrovanadium in 1974 was $2.94 per pound of alloy, compared with $3.08 in 1973.

No imports classified as vanadium ore and concentrate were received in 1974. Since January 1, 1974, imports of vanadium-bearing residues, such as ashes and slags, have been reported separately from other metal-bearing residues. They totaled 4.3 million pounds of contained vanadium in 1974. Most of this material came from the Republic of South Africa (51%), the U.S.S.R. (20%), and Chile (15%).

Imports of vanadium pentoxide, which hitherto have been of little consequence, totaled 1,904,182 pounds valued at $2,931,329 in 1974. These imports came from the Republic of South Africa, 1,738,628 pounds; Mozambique, 61,218 pounds; Finland, 60,075 pounds; West Germany, 44,259 pounds; and the United Kingdom, 2 pounds.

Ferrovanadium imports, which declined in quantity and value for the second consecutive year, are shown in table 7.

Table 6.—U.S. exports of vanadium, by country

(Thousand pounds and thousand dollars)

Destination	Ferrovanadium and other vanadium alloying materials containing over 6% vanadium (gross weight)				Vanadium ore, concentrates, pentoxide, vanadic acid, vanadium oxide, and vanadates (except chemically pure grade) (vanadium content)			
	1973		1974		1973		1974	
	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value
Algeria	66	198	--	--	--	--	--	--
Argentina	--	--	40	118	--	--	--	--
Austria	--	--	--	--	124	310	--	--
Belgium-Luxembourg	--	--	42	128	--	--	--	--
Brazil	33	97	53	169	--	--	12	35
Canada	614	1,844	1,198	3,527	26	57	3	13
Dominican Republic	(1)	1	--	--	--	--	--	--
France	--	--	4	11	95	183	--	--
Germany, West	349	1,080	--	--	40	115	90	310
Hong Kong	5	18	7	21	--	--	--	--
India	--	--	(1)	1	--	--	--	--
Jamaica	--	--	--	--	(1)	1	--	--
Japan	78	233	200	557	39	108	235	722
Malaysia	--	--	1	3	--	--	--	--
Mexico	13	39	194	423	42	110	24	84
Netherlands	433	1,453	454	1,488	37	99	--	--
Philippines	--	--	--	--	--	--	42	163
Poland	407	1,244	44	126	--	--	--	--
Spain	401	1,207	64	187	--	--	--	--
Sweden	314	989	359	1,081	--	--	--	--
Switzerland	96	275	10	23	--	--	--	--
United Kingdom	23	56	--	--	61	174	--	--
Total	2,832	8,734	2,670	7,863	464	1,157	406	1,327

[1] Less than ½ unit.

Table 7.—U.S. imports of ferrovanadium, by country

(Thousand pounds and thousand dollars)

Country	1973			1974		
	Gross weight	Vanadium content	Value	Gross weight	Vanadium content	Value
General imports:						
Australia	66	38	116	--	--	--
Austria	167	134	375	--	--	--
Belgium-Luxembourg	--	--	--	220	162	640
Canada	93	73	256	1	1	3
Germany, West	231	180	575	133	86	380
Norway	48	21	63	96	43	138
Total	605	446	1,385	450	292	1,161
Imports for consumption:						
Australia	66	38	116	--	--	--
Austria	108	99	254	--	--	--
Belgium-Luxembourg	--	--	--	221	162	640
Canada	93	73	256	1	1	3
Germany, West	154	120	364	128	82	361
Norway	133	63	184	96	43	138
Total	554	393	1,174	446	288	1,142

WORLD REVIEW

In addition to the nations listed in table 8, some others had relatively small vanadium production from secondary, waste, or byproduct sources. Japan and West Germany produced vanadium from several such sources.

Pipeline production was a major factor in demand for vanadium outside the United States in 1974. West Germany and Japan continued to be the largest consumers among the market economy countries.

Australia.—Foreign participation in Agnew Clough Ltd.'s vanadium project near Wundowie, about 47 miles northwest of Perth, Western Australia, was approved by the Australian Government. British Oxygen Ltd. and Mitsui and Co., Ltd. each held a 20% interest in the project and would guarantee markets for the vanadium. Site preparation would start in 1975, with the pelletizing, roasting, and leaching plant scheduled to come onstream toward the end of 1976 or early 1977.[2]

Bolivia.—Skoda Export, a Czechoslovakian company, began a feasibility study for a ferroalloy plant expected to be located near the city of La Paz. The plant would have a planned annual output capacity of 330 tons of ferrovanadium and 550 tons of ferrotungsten. Date for the start of its operation was tentatively scheduled for January 1977.[3]

Canada.—Vanadium oxides were not produced in Canada in 1974; Masterloy Products Ltd. suspended its production of vanadium pentoxide in June 1973. The company was having difficulty obtaining sodium fluorovanadate from the Aluminum Co. of Canada, Ltd. (ALCAN), which found it uneconomical to recover sodium fluorovanadate from its bauxite leaching circuit at Arvida, Quebec. Masterloy attempted to use fly ash from thermal power stations as a raw material, but this proved unsuccessful because of the inconsistency of the feed material. Masterloy still produced ferrovanadium by the aluminothermic process.

Chile.—Compañía de Acero del Pacífico was expanding steel capacity at its Huachipato plant, the source of Chile's vanadium-bearing slag, by 67%. The expansion would raise plant capacity to 1,102,310 tons of slag per year and was planned for completion by 1976.[4]

Finland.—According to Finnish trade statistics, Finland exported 2,594 tons of vanadium compounds[5] in 1973, of which 892 tons went to West Germany, 496 tons to Sweden, 443 tons to France, 331 tons to the U.S.S.R., and the balance to other European nations.

Rautaruukki Oy reported[6] that a new production record was achieved in the quantity of vanadium pentoxide produced at Otanmäki. Output increased by 18% from 2,248 tons in 1973 to 2,647 tons in 1974. The company completed planning of the process and plant for the Mustavaara mine during 1973, and construction was started in 1974. Mining would be by open pit methods with production scheduled to begin in 1976. The main product of this operation would be vanadium pentoxide, with the plant designed to produce 3,000 tons per year.

Germany, West.—According to official trade statistics, West Germany imported 32,848 tons (gross weight) of vanadium-containing ashes, residues, and slag in 1974, compared with 33,644 tons in 1978.

India.—The Geological Survey of India analyzed samples from a titanomagnetite deposit in the Chennagiri Taluk of Shimoga District, Karnataka State, and found that they ranged from 0.43% to 0.76% vanadium. Earlier work on a bulk sample of titanomagnetite ore from Devaranarasipur, near Bhadravati in Shimoga District, showed a content of 0.50% vanadium.

South Africa, Republic of.—Production of vanadium-bearing slag by Highveld Steel and Vanadium Corp., Ltd.,[7] totaled 38,053 tons (gross weight) in the fiscal year ending June 30, 1974, compared with 37,560 tons in the previous fiscal year. Fused vanadium pentoxide production from the company's Vantra Division was reduced during fiscal year 1974, due to an oversupply position, particularly in Europe. Since the suspension in 1972 of mining operations by Transvaal Vanadium Co. (Pty.) Ltd., a wholly-owned subsidiary of Highveld, at its Kennedy's Vale mine, Lydenburg district, ore for the Vantra Division has been supplied by Highveld's own Mapochs mine, situated near the village of Roosenekal in the Middelburg district, Transvaal.

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[2] Metal Bulletin (London). Vanadium Boost for Wundowie. No. 5945, Nov. 29, 1974, p. 39.

[3] U.S. Embassy, La Paz, Bolivia. Industrial Outlook Report: Minerals 1972–1973. State Department Airgram A-136, July 15, 1974, p. 33.

[4] Walker, P. Chile Puts Steel Goals at Million Tons a Year. Am. Metal Market, v. 81, No. 49, Mar. 12, 1974, pp. 1, 14.

[5] Although the title of the export class is "vanadium compounds," the material is almost all vanadium pentoxide.

[6] Rautaruuki Oy. 1974 Annual Report. Pp. 8, 12, 13.

[7] Highveld Steel and Vanadium Corp., Ltd. Interim Report for the Half Year Ended 31st December 1974. Witbank, Feb. 4, 1975.

The R14 million expansion plan of Highveld Steel and Vanadium Corp., Ltd., mentioned in last year's chapter, has progressed well. The company hoped to commission the fifth furnace and sixth kiln in the iron plant early in 1975, and in the steel plant, the fourth continuous casting machine was expected to be commissioned in the middle of 1975.[8]

The vanadium pentoxide plant of Transvaal Alloys Ltd., a joint venture of the Otavi mining group and Vereinigte Aluminium-Werke A.G. of West Germany, began production in July.[9] The plant, which will mainly supply Japan, is located near Stoffberg and has a product capacity of 840 tons of contained vanadium. Vanadium for the plant is from a titaniferous magnetite deposit near Uitvlugt, Transvaal.

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[8] Highveld Steel and Vanadium Corp., Ltd. Annual Report 1974. 28 pp.

[9] Metal Bulletin (London). Otavi V on Stream. No. 5913, Aug. 6, 1974, p. 21.

Table 8.—Vanadium: World production from ores and concentrates, by country

(Short tons of contained vanadium)

Country	1969	1970	1971	1972	1973	1974 [p]
Chile [e] [1]	600	610	660	720	1,060	820
Finland (in vanadium pentoxide product)	1,484	1,450	1,222	1,312	1,388	1,685
France [2]	[r] 106	(3)	(4)	(4)	(4)	--
Norway [e]	1,110	1,190	[r] 1,110	[r] 950	800	860
South Africa, Republic of: [5]						
Content of pentoxide and vanadate products	[r] 2,858	[r] 2,659	[r] 4,409	[e] [r] 3,203	[e] [r] 3,511	[e] 3,684
Content of vanadiferous slag product [e]	3,300	[r] 4,468	[r] 4,057	[r] 4,864	[r] 5,536	5,577
Total	[e] [r] 6,158	[e] [r] 7,127	[e] [r] 8,466	[r] 8,067	[r] 9,047	9,261
South West Africa, Territory of: (in lead vanadate concentrate) [6]	[r] 552	[r] 443	[r] 875	[r] 583	[r] 715	903
U.S.S.R. (in slag exports only)	[r] 3,433	[r] 3,800	2,917	3,720	4,246	[e] 4,300
United States (recoverable vanadium)	5,577	5,319	5,252	4,887	4,377	4,870
Total	19,020	[r] 19,939	[r] 20,502	[r] 20,239	[r] 21,633	22,149

[e] Estimate. [p] Preliminary. [r] Revised.

[1] Based on reported United States imports from Chile.

[2] Content of vanadic acid derived from bauxite.

[3] Available sources suggest that production was terminated during 1970, but no production figures for that year were released.

[4] Revised to zero on the basis of sources indicating that production was terminated during 1970.

[5] The Republic of South Africa officially reported the production of vanadium in pentoxide and vanadate products for 1969–71, and an undistributed total production for 1972–74. Data on vanadium content of slag for all years in this table have been estimated on the basis of a reported tonnage of vanadium-bearing slag (on a gross weight basis) multiplied by an assumed grade of 14% vanadium in the slag. Thus, output of vanadium in slag as well as total vanadium output figures for 1969–71 are estimated (as the result of adding an estimate for vanadium in slag to a reported figure for vanadium in pentoxide and vanadate products). Similarly, the distribution of total production of contained vanadium between the content of pentoxide and vanadate products and the content of slag are estimates derived by subtracting the estimated content of slag from the reported total vanadium output.

[6] Series revised to reflect reported output of South West Africa Co. Ltd. for years ending June 30 of that stated.

TECHNOLOGY

A process for extracting vanadium from weathered shale containing about 1% V_2O_5 was developed on a laboratory scale by the Bureau of Mines. Testing was done using shales from a deposit near Carlin, Nev., and an extraction of 69% was achieved. The vanadium-bearing beds in this area are part of the Woodruff Formation of Devonian age. Two distinct types of shale, which differed in response to metallurgical treatment, were studied: Dark-brown carbonaceous or unweathered shale containing about 10% organic carbon, and gray-weathered shale containing less than 1% of organic carbon. The process consists essentially of salt roasting, leaching with dilute sulfuric acid, solvent extraction, and precipitation of vanadium as ammonium metavanadate. The carbonaceous unweathered shale was less amenable to treatment.[10]

Experimental work was conducted on the coreduction of titanium, aluminum, and vanadium chlorides by the Kroll (magnesium reduction) process to produce a homogeneous titanium alloy sponge. The yields of sponge were comparable with those of pure titanium sponge made in the same reactor. When VCl_4 in solution in $TiCl_4$ was fed into the molten magnesium, the vanadium concentration was very uniform throughout the sponge cake. More difficulty was encountered when feeding solid VCl_2 and $AlCl_3$. Vanadium and aluminum concentration in the sponge was not uniform, and mechanical difficulties were experienced with the small-scale screw feeder. Although the composition varied in various regions of the sponge cake, the ingots prepared from it were uniform in composition.[11]

The experimental technique developed by the Bureau of Mines for measuring the rate of electrochemical reaction between reactive metal electrodes and molten salt electrolytes containing multivalent ions was applied to the vanadium metal-vanadium subchloride system. The rate was found to be dependent on current density and VCl_3 concentration but almost independent of VCl_2 concentration.[12]

Samples of Devonian, Silurian, and Ordovician crude oils from Illinois were analyzed by neutron activation analysis for their vanadium content.[13] Concentrations, which ranged from 0.03 to 3.72 micrograms per milliliter, were low in crudes that came from reservoirs that were greater than 3,200 feet in depth. Maps of vanadium concentrations in these crudes appear to reflect structural features, such as the Sparta Shelf and the Sangamon Arch.

The electrolytic hydrogen evolution reaction (HER) was studied on vanadium in sulfuric acid-sulfate solutions. Data include Tafel slope, exchange current density, apparent heat of activation, reaction order derivative, corrosion potential, corrosion current, and hydrogen adsorption in gas phase.[14]

Thin sections can be removed from vanadium metal by a combined anodizing and stripping technique. A uniform, thin oxide film can be grown on the vanadium metal in an acetone-benzoic acid-sodium tetraborate solution during anodization, followed by stripping of the resulting oxide film in an aqueous solution of 10% NH_4OH. The section thickness varies linearly with the applied voltage across the cell. This technique can be applied for constructing penetration profiles in diffusion studies.[15]

A study on the solid-solubility limit of nitrogen in vanadium covering the temperature range 500° to 1,500° C and using several different techniques was carried out.[16] It is part of more extended ongoing investigations concerned with transformation and precipitation processes in the system vanadium-nitrogen.

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[10] Brooks, P. T., and G. M. Potter. Recovering Vanadium From Dolomitic Nevada Shale. BuMines RI 7932, 1974, 20 pp.

[11] Henry, J. L., W. E. Anable, and J. L. Schaller. Pioneering Experiments on the Coreduction of Titanium, Aluminum, and Vanadium Chlorides To Produce Titanium Alloy Sponge. BuMines RI 7934, 1974, 21 pp.

[12] Raddatz, A. E., and D. J. MacDonald. Electrochemical Anodic Reaction Rate of Vanadium Metal With Molten VCl_2-VCl_3-NaCl Mixtures. BuMines RI 7986, 1974, 9 pp.

[13] Mast, R. F., R. R. Ruch, and W. F. Meents. Vanadium in Devonian, Silurian, and Ordovician Crude Oils of Illinois. Ill. State Geol. Survey Circ. 483, 1973, 14 pp.

[14] Bélanger, A., and A. K. Vijh. Hydrogen Evolution Reaction on Vanadium, Chromium, Manganese, Cobalt. J. Electrochemical Soc., v. 121, No. 2, February 1974, pp. 225–230.

[15] Pelleg, J. A Microsectioning Technique for Vanadium. J. of the Less-Common Metals, v. 35, No. 2, April 1974, pp. 299–304.

[16] Hörz, G. Solid Solubility Limit of Nitrogen in Vanadium at Temperatures between 500° and 1,500° C. Precipitation Phenomena in the System Vanadium-Nitrogen. J. of the Less-Common Metals, v. 35, No. 2, April 1974, pp. 207–225.

Vermiculite

By Frank B. Fulkerson [1]

Crude vermiculite output totaled 341,000 short tons in 1974, a decline of 7% from the record 365,000 short tons produced in 1973. Crude vermiculite, mined and milled in Montana and South Carolina, was shipped to 53 exfoliating plants in 31 States for processing. Exfoliated vermiculite was used mainly in the building industry as concrete aggregate; as premixes for acoustic, fireproofing, and other purposes; and as loose fill and block insulation. Demand for the lightweight product was reported to be strong, despite a decline in building activity; however, owing to a decrease in supply of crude vermiculite, the quantity of exfoliated vermiculite sold or used by producers declined 6%.

Table 1.—Salient vermiculite statistics

	1970	1971	1972	1973	1974
United States: Sold and used by producers:					
Crude -------- thousand short tons --	285	301	337	365	341
Value -------- thousand dollars --	$6,501	$7,198	$8,092	$9,464	$10,120
Average value per ton ----------	$22.81	$23.91	$24.01	$25.93	$29.68
Exfoliated ----- thousand short tons --	221	209	247	293	275
Value -------- thousand dollars --	$18,809	$20,885	$24,777	$31,186	$30,916
Average value per ton -----------	$85.11	$99.93	$100.31	$106.44	$112.42
World: Production, crude thousand short tons --	431	459	512	549	554

DOMESTIC PRODUCTION

Crude Vermiculite.—Output decreased from 365,000 short tons in 1973 to 341,000 short tons in 1974. Owing to startup problems at the new $7 million wet-processing plant of W. R. Grace & Co., Construction Products Division, at Libby, Mont., full operation was not expected until 1975. Ore reserves near Libby were reported to be sufficient for 50 years at the present rate of mining.[2] W. R. Grace & Co. also mined vermiculite near Enoree, S.C. In addition, Patterson Vermiculite Co. produced a small tonnage at Lanford, S.C. Plans of W. R. Grace & Co. to develop vermiculite deposits near Louisa, Va., were shelved as the result of zoning problems.

Exfoliated Vermiculite.—Several exfoliators reported they would have processed more crude vermiculite if it had been available. The tonnage of exfoliated vermiculite sold or used decreased from 293,000 in 1973 to 275,000 in 1974. Leading States, accounting for 46% of the exfoliated vermiculite sold or used, were, in alphabetical order, California, Florida, New Jersey, South Carolina, and Texas. W. R. Grace & Co., Construction Products Division, the principal producer of crude vermiculite, operated 28 exfoliating plants in 22 States. A quantity of crude vermiculite from the Republic of South Africa was exfoliated in the United States.

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[1] Industry economist, Division of Nonmetallic Minerals.

[2] W. R. Grace & Co. 1974 Annual Report. P. 15.

CONSUMPTION AND USES

The use pattern for exfoliated vermiculite by main categories was as follows: Aggregates, 52%; insulation, 29%; agriculture, 17%; and miscellaneous, 2%. End uses in 1973 and 1974 follow, in thousand tons:

Use	1973	1974
Aggregates:		
Concrete	88	94
Plaster	7	5
Premixes [1]	42	42
Total	137	141
Insulation:		
Loose fill	82	47
Block	9	32
Packing	1	1
Total	92	80
Agriculture:		
Horticulture and soil conditioning	40	40
Fertilizer carrier	9	7
Other	1	--
Total	50	47
Miscellaneous	14	6
Grand total	293	274

[1] Includes vermiculite used in premixes for acoustic and fireproofing purposes, decorative textures, moisture sealant, etc.

PRICES

According to the Bureau of Mines canvass, the average value of crude vermiculite was $29.68 per ton, compared with $25.93 in 1973, and the average value of exfoliated vermiculite was $112.42 per ton, compared with $106.44 in 1973. These values are f.o.b. mine or plant and exclude container cost where applicable.

The Engineering and Mining Journal quoted nominal yearend prices for crude vermiculite as follows: Per short ton, f.o.b. mine, domestic ore, $30 to $48; and c.i.f. Atlantic ports, the Republic of South Africa ore, $55 to $70.

FOREIGN TRADE

The Republic of South Africa was the only significant source of vermiculite imports. The crude vermiculite was imported duty-free into the United States. A quantity of crude ore was exported from the United States to Canada; however, tonnage figures were not published.

WORLD REVIEW

Canada.—Most of the crude vermiculite exfoliated in Canada was imported from Montana; some was imported from the Republic of South Africa. Grace Construction Materials Ltd. operated exfoliating plants at St. Thomas and Ajax, Ontario; Winnipeg, Manitoba; Regina, Saskatchewan; Edmonton, Alberta; and Vancouver, British Columbia. F. Hyde & Co., Ltd. and Vermiculite Insulating Ltd. operated exfoliating plants at Montreal and Lachine, Quebec, respectively. The use pattern in 1973 was loose insulation, 73%; insulating concrete, 7%; insulating plaster, 3%; and miscellaneous 17%.[3]

South Africa, Republic of.—Vermiculite ore produced in the Transvaal, Republic of South Africa, is exported through the Port of Lourenço Marques in Mozambique. Exports in 1974 declined because political unrest in Mozambique caused work stoppages at the port. There were long delays in berthing and loading ships. Many rail cars were also blocked because their freight could not be unloaded, and this resulted in a shortage of rail cars. By yearend, the flow of vermiculite shipments through the port had returned to normal.[4]

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[3] Stonehouse, D. H. Lightweight Aggregates, 1973. Can. Dept. Energy, Mines, and Res., (Ottawa), 1974, 5 pp.

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[4] Engineering and Mining Journal. V. 176, No. 3, March 1975, pp. 204–205.

Table 2.—Republic of South Africa: Exports of vermiculite by country

(Short tons)

Country	1972	1973	1974
Australia	3,176	NA	NA
Belgium	1,461		
Canada	5,103		
Finland	1,011		
France	14,763		
Germany, West	13,941		
Ireland	1,019		
Israel	1,075		
Italy	20,935		
Japan	8,522		
Netherlands	1,153		
Spain	4,938		
Sweden	2,652		
Switzerland	1,078		
United Kingdom	31,461		
United States	26,448		
Undisclosed	3,390		
Total	142,126	157,491	164,977
Total value [1]	$3,715,372	$4,791,597	$5,323,066
Average value per ton [1]	$26.14	$30.42	$32.27

NA Not available.

[1] Converted to U.S. currency at the rate of 1 rand equals U.S. $1.40.

Table 3.—Vermiculite: World production by country [1]

(Short tons)

Country	1972	1973	1974 p
Argentina	4,572	2,809	e 2,700
Brazil e	5,000	5,000	5,000
India	1,699	3,031	3,010
Kenya	1,027	960	e 900
South Africa, Republic of	163,035	172,469	201,296
Tanzania	--	--	22
United States (sold or used by producers)	336,798	365,000	341,000
Total	512,131	549,269	553,928

e Estimate. p Preliminary.

[1] Market economy countries only.

Table 4.—Vermiculite exfoliating plants in the United States in 1974

Company	State	County	Nearest city or town
Ari-Zonolite Co	Arizona	Maricopa	Phoenix.
J. P. Austin Assoc., Inc	Pennsylvania	Beaver	Beaver Falls.
J. J. Brouk & Co., Inc	Missouri	St. Louis	St. Louis.
Carolina Wholesale Florists, Inc	North Carolina	Lee	Sanford.
Diversified Insulation, Inc	Minnesota	Hennepin	Minneapolis.
Cleveland Building Materials Supply Co., Cleveland Gypsum Co. Div.	Ohio	Cuyahoga	Cleveland.
W. R. Grace & Co., Construction Products Div.	Arkansas	Pulaski	North Little Rock.
	California	Alameda	Newark.
		Los Angeles	Los Angeles.
		Orange	Santa Ana.
	Colorado	Denver	Denver.
	Florida	Broward	Pompano Beach.
		Duval	Jacksonville.
		Hillsborough	Tampa.

Table 4.—Vermiculite exfoliating plants in the United States in 1974—Continued

Company	State	County	Nearest city or town
W. R. Grace & Co., Construction Products Div.—Continued	Illinois	Cook	Chicago.
		DuPage	West Chicago.
	Kentucky	Campbell	Newport.
	Louisiana	Orleans	New Orleans.
	Maryland	Prince Georges	Muirkirk.
	Massachusetts	Hampshire	Easthampton.
	Michigan	Wayne	Dearborn.
	Minnesota	Hennepin	Minneapolis.
	Missouri	St. Louis	St. Louis.
	Nebraska	Douglas	Omaha.
	New Jersey	Mercer	Trenton.
	New York	Cayuga	Weedsport.
	North Carolina	Guilford	High Point.
	Oregon	Multnomah	Portland.
	Pennsylvania	Lawrence	New Castle.
	South Carolina	Greenville	Travelers Rest.
		Laurens	Enoree.
	Tennessee	Davidson	Nashville.
	Washington	Spokane	Spokane.
	Wisconsin	Milwaukee	Milwaukee.
Hyzer & Lewellen	Pennsylvania	Bucks	Southampton.
International Vermiculite Co	Illinois	Macoupin	Girard.
Koos, Inc	Wisconsin	Kenosha	Kenosha.
La Habra Products, Inc	California	Orange	Anaheim.
MacArthur Co	Minnesota	Ramsey	St. Paul.
Mica Pellets, Inc	Illinois	De Kalb	De Kalb.
Patterson Vermiculite Co	South Carolina	Laurens	Lanford.
Robinson Insulation Co	Montana	Cascade	Great Falls.
	North Dakota	Ward	Minot.
Schmelzer Sales Associates, Inc	Florida	Hillsborough	Tampa.
The Schundler Co	New Jersey	Middlesex	Edison.
Strong-Lite Products	Arkansas	Jefferson	Pine Bluff.
Supreme Perlite Co	Oregon	Multnomah	Portland.
Texas Vermiculite Co	Oklahoma	Oklahoma	Oklahoma City.
	Texas	Bexar	San Antonio.
		Dallas	Dallas.
Vermiculite of Hawaii, Inc	Hawaii	Honolulu	Honolulu.
Vermiculite-Intermountain, Inc	Utah	Salt Lake	Salt Lake City.
Vermiculite Products, Inc	Texas	Harris	Houston.

Zinc

By V. Anthony Cammarota, Jr.,[1] and Herbert R. Babitzke[1]

The slackening demand for zinc that began late in 1973 continued through 1974, principally as a result of the downturn in automobile production. Consumption of slab zinc decreased 14% from that of 1973 to 1,287,696 tons.

Mine production in 1974 was 499,872 tons, up 4% from that of 1973. New York, Missouri, and Tennessee were the principal producing States accounting for 54% of domestic production. Two new mines, one each in Tennessee and Utah, were developed for commercial production in 1975.

Smelter production of slab zinc from ore was 555,188 tons in 1974, a 5% decrease from that of 1973. This continued the declining trend that started in 1970. Two companies announced plans to erect two new electrolytic zinc smelters. Upon completion of the plants, possibly in 1977, domestic capacity will be increased by 340,000 tons annually to over 1 million tons. One plant is to be located at Clarkesville, Tenn., and the other at Stephensport, Ky. A new electrolytic zinc refinery is under construction at Bartlesville, Okla., to replace the horizontal zinc smelter. The Texas Air Control Board extended permission to operate the other remaining horizontal retort smelter until May 31, 1975, the date scheduled for closure.

Exports of slab zinc increased 31%. General imports of zinc in ores and concentrates increased 20% over those of 1973 to 240,043 tons, mainly through increased receipts from Canada. Imports for consumption of zinc ores and concentrates declined 13% to 133,733 tons. In 1974, both general imports and imports for consumption of slab zinc were nearly the same, at 539,538 tons and 543,806 tons, respectively, representing decreases of about 8% from those in 1973. Canada provided over half of the slab zinc imports, followed by Japan, Australia, Peru, and Belgium-Luxembourg.

The General Services Administration (GSA) continued to release zinc from the national stockpile as authorized by Public Law 92–283. On the first of January 412,385 tons of zinc were available for commercial disposal. Early in the year GSA started a new set-aside program by offering 150,000 tons over a period of 1 year with 75,000 tons available for the second quarter of 1974 and 25,000 tons each quarter thereafter. GSA sales of stockpile zinc in 1974 amounted to 264,325 tons, leaving a balance of 148,060 tons authorized for release.

Legislation to suspend the duty on imports of zinc concentrates was vetoed by the President because it contained a nongermane tax rider. The bill would have suspended through June 30, 1977, the 0.67 cents per pound import tariff on zinc ores, concentrates, and certain other zinc-bearing materials.

The monthly average price of domestic Prime Western zinc ranged from 31.2 cents per pound for January to 39.3 cents per pound for September. The yearend quoted price was 38 to 40 cents per pound, with the average for 1974 at 35.95 cents per pound. The London Metal Exchange (LME) price rose from 61.3 to 96.6 cents per pound from January to May, then declined sharply to the yearend quotation of 32 cents per pound.

Legislation and Government Programs.—GSA continued the sale of zinc from the stockpile during 1974. Commercial sales totaled 264,325 tons in 1974; 124,416 tons was sold under the set-aside program, and

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[1] Physical scientist, Division of Nonferrous Metals.

139,909 tons was sold to the seven participating primary producers. Part of the zinc sold was from the 55,085 tons that remained from 1973 under authorization of Public Law 92–283. To that amount of zinc, Public Law 93–212 of December 28, 1973 added 357,300 tons for a total amount authorized of 412,385 tons. Based on inventories, zinc shipments from the stockpile in 1974 were 285,409 tons. This amount included shipments of zinc that had been sold to the Department of the Treasury in 1970. Government agencies also received an additional 1,592 tons of zinc leaving a balance of 20,388 tons for Government use as authorized by Public Law 89–9.

Under Public Law 93–212, 207,300 tons was to be released to primary domestic producers in continuation of their contracts and 150,000 tons was made available on the set-aside sales program for U.S. consumers. Four grades were made available as follows: High Grade, Intermediate, Brass Special, and Prime Western. The set-aside program offered 75,000 tons for the April through June period, and 25,000 tons for each of the following three quarters commencing with July 1974.

The price of the set-aside Prime Western, Intermediate, and Brass Special Grades was at the Metals Week monthly average quotation for domestic Prime Western zinc for the month following delivery. High Grade zinc was sold at the Metals Week average price for the month of delivery. All sales were f.o.b. storage location with a 0.75-cent-per-pound freight allowance. The price basis for producer contracts was the Metals Week average for the actual month of delivery. Additional allowances were permitted producers of secondary slab zinc, importers, and distributors and dealers of slab zinc as follows: For direct shipment, 0.45 cents per pound and for melting and recasting into slab zinc, 0.95 cents per pound.

The International Lead and Zinc Study Group held its eighteenth session in Geneva, Switzerland, November 13–18, 1974, to review developments in lead and zinc and consider projections for 1974 and 1975. The Group completed work on a special report on secondary lead and zinc and compiled a comprehensive list of new mine and smelter projects. The report showed that about one-fourth of world zinc consumption was supplied from secondary material.

Table 1.—Salient zinc statistics

	1970	1971	1972	1973	1974
United States:					
Production:					
Domestic ores, recoverable content ---------- short tons --	534,136	502,543	478,318	478,850	499,872
Value --------- thousands --	$163,650	$161,819	$169,808	$197,861	$358,908
Slab zinc:					
From domestic ores short tons --	403,953	403,750	400,969	r 399,119	346,993
From foreign ores -- do ----	473,858	362,683	232,211	r 184,360	208,195
From scrap --------- do ----	77,156	80,923	73,718	r 83,187	78,535
Total ----------- do ----	954,967	847,356	706,898	r 666,666	633,723
Secondary zinc[1] -------- do ----	264,074	279,399	314,043	300,073	259,947
Exports of slab zinc --------- do ----	288	13,346	4,324	14,566	19,062
Imports (general):					
Ores (zinc content) ---- do ----	525,759	342,521	254,868	r 199,634	240,043
Slab zinc --------------- do ----	270,413	319,586	522,612	r 592,046	539,583
Stocks, December 31:					
At producer plants ------ do ----	r 124,194	r 48,574	r 30,068	r 25,947	39,720
At consumer plants ---- do ----	92,674	91,523	124,956	114,317	210,749
Government stockpile --- do ----	1,141,490	1,137,937	949,583	677,009	391,600
Reprocessed GSA zinc[2] -- do ----	NA	NA	80,403	109,333	42,850
Consumption:					
Slab zinc --------------- do ----	1,186,951	1,254,059	1,418,349	1,503,938	1,287,696
All classes --------------- do ----	1,571,596	1,650,694	1,844,023	1,931,925	1,673,013
Price: Prime Western[3] cents per pound --------------------------	15.32	16.13	17.75	20.66	35.95
World:					
Production:					
Mine ------------- short tons --	6,023,488	6,079,365	r 5,992,071	r 6,296,833	6,384,384
Smelter -------------- -- do ----	5,320,771	5,228,959	r 5,655,754	r 5,847,689	5,968,184
Price: Prime Western London equivalent ----- cents per pound --	13.36	14.08	17.13	38.55	56.13

r Revised. NA Not available.

[1] Excludes redistilled slab zinc.

[2] Included in total amount withdrawn from Government stockpile.

[3] 1970, East St. Louis price; 1971–74 delivered price.

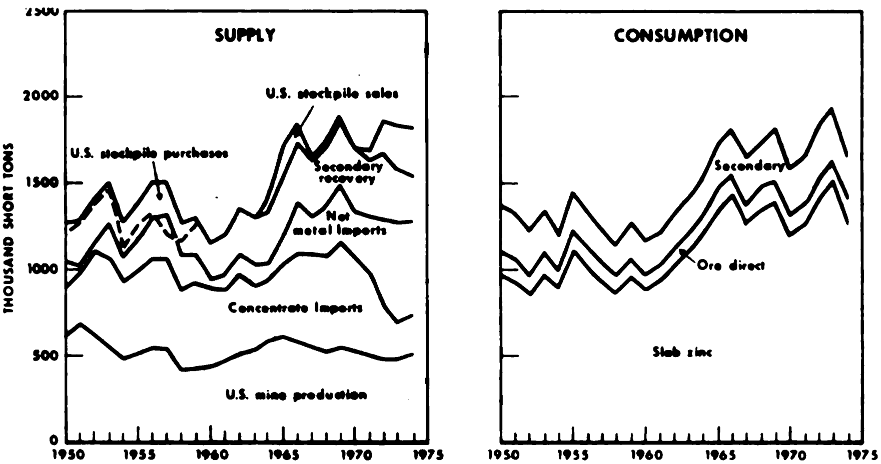

Figure 1.—Trends in supply and consumption in the United States.

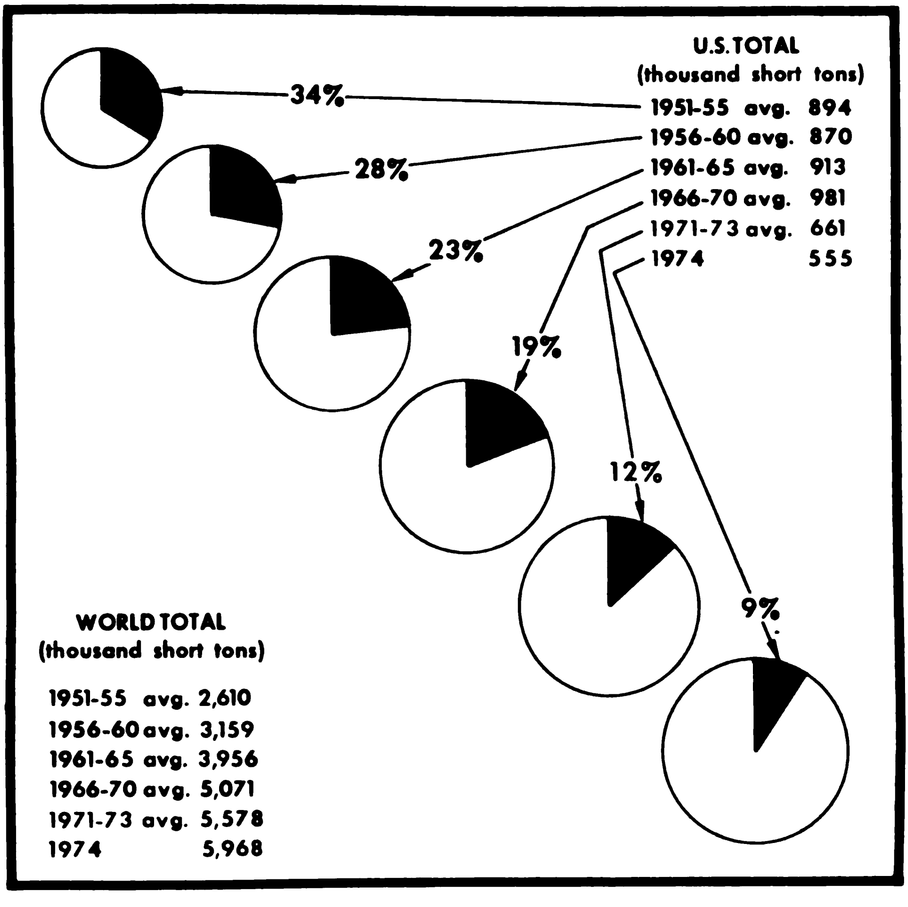

Figure 2.—Trends of United States percentage of world smelter production.

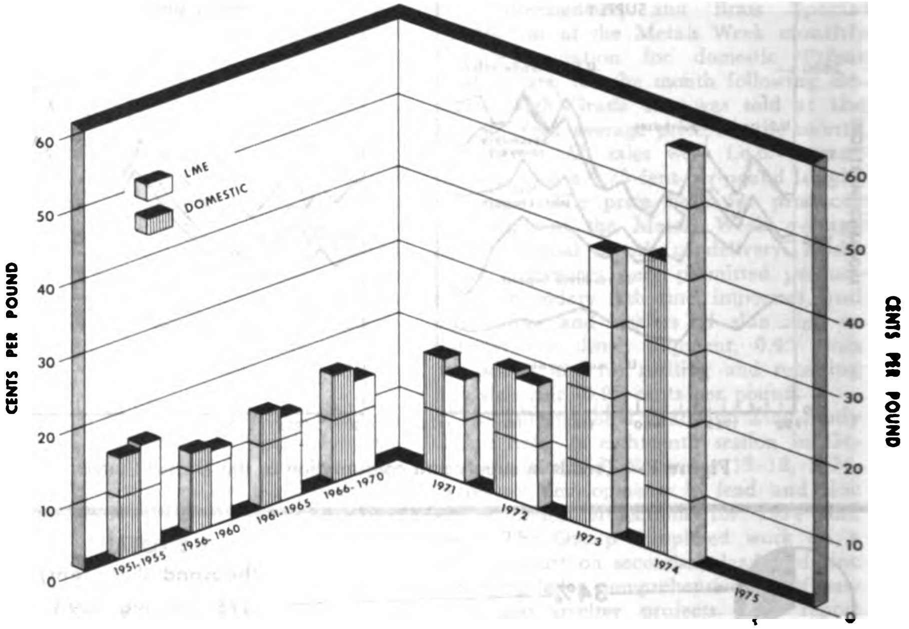

Figure 3.—Trends in average foreign and domestic zinc prices.

DOMESTIC PRODUCTION

MINE PRODUCTION

Mine production in the United States was 499,872 tons of recoverable zinc, an increase of 4% over that of 1973. Significant increases were recorded for Missouri, New York, and Tennessee, but significant decreases were noted for Colorado, Idaho, Maine, and Utah. Nevada produced zinc for the first time since 1971. New York was the leading producing State in 1974 with 19% of the total production, followed by Missouri, 18%; Tennessee, 17%; and Colorado, 10%.

Sources of the zinc production for 1974 are shown in table 4 according to the class of ore in terms of recoverable metals. The distribution of zinc by various classes of ore is as follows: Zinc ore, 59%; zinc-lead ore, 15%; lead ore, 19%; copper-zinc and copper-lead-zinc ore, 4%; and other sources, 3%.

The 25 leading mines listed in table 5 accounted for 90% of the recoverable domestic zinc mined in 1974. The five leading mines produced 42% of the total and the first 10 mines produced 61%.

Zinc mine production in New York increased 14% over that of 1973, all of which came from the Balmat-Edwards mining complex of St. Joe Minerals Corp. The level of production of zinc in concentrates continued to improve. The Balmat mill serving the Balmat mine operated near its capacity of 4,300 tons per day. The Edwards mill treated ore from the Edwards mine. Total quantity of zinc concentrates produced in 1974 was 221,436 tons.[2] The Hyatt mine located between the Balmat and Edwards mines was reopened as a result of drilling that located zinc ore below existing workings in the old mine which had been abandoned about 20 years ago. It was reported that the Hyatt mine may replace production from the Edwards mine where deposits are expected to be depleted in 5 years. Limited production at the Hyatt mine began late in 1974 and exploration continued.

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[2] St. Joe Minerals Corp. 1974 Annual Report. P. 16.

Zinc production in Missouri, up 12% from that of 1973, was derived wholly from eight lead mines. St. Joe Minerals Corp. lead mines in southeast Missouri (Fletcher, Viburnum Nos. 27, 28, and 29, and Brushy Creek) increased production of zinc in concentrates almost 100% over 1973 production. Brushy Creek operated at close to capacity during 1974 and played an important role in the improvement of production over 1973 levels.[3] The Missouri mine-mill-smelter complex, jointly owned by AMAX Inc. and Homestake Mining Co. produced 110,400 tons of zinc concentrates from the Buick mine in 1974. Production was down 6,100 tons when compared with that of 1973 because of slight decreases in ore grade.[4] The Magmont mine at Bixby, Mo., operated by Cominco American Incorporated, a joint venture of Cominco, Ltd. (50%) and Dresser Industries, Inc. (50%), produced 1,042,000 tons of ore at a combined lead-zinc grade of 8.2%.[5] Ozark Lead Co., a wholly-owned subsidiary of Kennecott Copper Corp., continued to produce zinc as a byproduct of lead.

Tennessee ranked third in domestic zinc mine production in 1974 with an increase of 34% over that of 1973. The New Jersey Zinc Co. continued exploration work near Carthage in central Tennessee. Mining commenced in 1974 at the Elmwood mine, although no production was reported, and the company completed construction of its new zinc mill. The mill has standard flotation cells, preceded by heavy media separation. The rated capacity of the concentrator is 3,500 tons per day of crude ore to produce a 63% zinc concentrate, aggregate stone, and limestone. The concentrate will be shipped by rail to the company smelter at Palmerton, Pa., until the new zinc plant at Clarksville, Tenn., is completed. The company announced that the deposit contained 20 million tons of zinc ore grading 4.5% to 5% zinc. By yearend 1974 about 25,000 feet of lateral development was completed. The company was also drilling a pilot hole for a new mine 2 miles southeast of the main shaft of the Elmwood mine. The New Jersey Zinc Co. began dewatering the Idol mine in east Tennessee, and additional underground exploration was scheduled. Plans were to do selective high-grade mining and to install a small mill for processing 4% to 4.5% zinc ore. The Flatgap mine will remain on standby, although the mill was dismantled and the equipment was installed at the Elmwood mill.

The Getty Oil Co. announced a 3-year, $2.3 million joint venture exploration project in Tennessee with Kinsho-Mataichi Corp., Dowa Mining Co., Ltd., Mitsubishi Metal Corp., and Mitsubishi Corp. Getty will control and direct the project and the Japanese companies will fund 80% of the cost. Occidental Minerals Corp. (Oxymin) increased its lease holdings near Carthage to 14,400 acres, and an agreement was made with a mining company to continue exploration and possible development of the project.[6] American Smelting and Refining Company (ASARCO) proceeded on schedule with construction of the Young mill which should be operational by mid-1975. The Young mill will have the capacity to treat increased output from ASARCO's Tennessee mines, which was 56,400 tons of zinc in 1974, nearly double that of 1973.[7] Cities Service Co. continued production of zinc concentrate at its Copperhill, Tenn., operations. Sales of concentrate decreased substantially to 6,400 tons, 65% less than those of 1973.[8]

Mine production in Colorado decreased 15% from that of 1973 to 49,489 tons. The Eagle mine of The New Jersey Zinc Co. was the leading zinc producer in the State. The Leadville mine (called Resurrection mine by Newmont Mining Corp.), a joint venture shared equally by Newmont and ASARCO was the second largest producer in the State. It produced 12,400 tons of zinc in 1974, a decrease of 15% compared with 1973 production.[9] Average zinc content of the ore milled was 9.6% zinc. Ore reserves were estimated at 2,655,000 tons averaging 9.4% zinc. The third largest zinc producer in Colorado was the Newmont Idarado mine. The Idarado mill treated 396,600 tons of ore averaging 3.33% zinc. Production increased 5% over that of 1973. Ore reserves were increased at the end of 1974 to 3,882,000 tons averaging 4.41% zinc.[10]

Zinc mine production in Idaho for 1974

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[3] Work cited in footnote 2.

[4] AMAX Inc. 1974 Annual Report. P. 5.

[5] Cominco, Ltd. 1974 Annual Report. P. 14.

[6] Occidental Petroleum Corp. 1974 Annual Report. P. 16.

[7] American Smelting and Refining Company. 1974 Annual Report. Pp. 5 and 18.

[8] Cities Service Co. 1974 Annual Report. P. 34.

[9] Page 18 of work cited in footnote 7.

[10] Newmont Mining Corp. 1974 Annual Report. P. 6.

was 39,469 tons, a decrease of 14% from that of 1973. Increased development work resulted in higher confirmed ore reserves for the Bunker Hill and Star mines. In 1974, proven reserves at the Bunker Hill mine were increased to 2,493,600 tons of ore with a zinc content of 3.5%. Proven reserves at the Star mine were 624,000 tons of ore with a zinc content of 7.2%. The average grade of Bunker Hill reserves declined as a consequence of the addition of substantial low-grade reserves in the upper portion of the mine. Programs for increasing ore reserves through both internal and external exploration will continue over the next several years.[11]

The Hecla Mining Co. Lucky Friday mine produced 165,695 tons of silver ore assaying 1.18% zinc. Tonnage of ore mined decreased from that of 1974 due to a shortage of experienced underground miners. Development of the ore body at the 4,050-foot level was essentially completed and the tenor of ore corresponded favorably with that on the level above. The main shaft was deepened by 162 feet to reach below the 4,450-foot level.

Sunshine Mining Co. is the operator of the Sunshine unit area and mines the ore owned by Hecla, Sunshine, and Silver Dollar Mining Co. Development work on the 4,200- and 5,400-foot levels expanded the limits of two veins. The exposures were encouraging since they are situated along a previously unproductive structure. The tailings pond capacity was increased during the year, thus providing sufficient space for mill tailings for the next several years.[12] Day Mines, Inc., through an independent contractor, produced 22,118 tons of ore from the Monitor mine in 1974. The ore which averaged 4.58% zinc also contains silver and lead. Ore reserves were estimated to be adequate for approximately 1½ years of operation at the current rate of production.[13]

Production in New Jersey, Pennsylvania, and Virginia by The New Jersey Zinc Co. increased 3% over that of 1973. All the ore mined was milled near the mines and the concentrate was shipped to the company refinery at Palmerton Pa.[14]

Mine production at the Blue Hill mine in Maine decreased 47% from that of 1973 to 10,425 tons in 1974. During the year the mill treated 206,400 tons of ore with an average zinc content of 6.44%. Minable reserves at yearend were 701,000 tons of ore with a zinc content of 5.31%.[15]

Mine production in Utah declined to 12,619 tons in 1974, a decrease of 25% from that of 1973. Despite lower production of zinc, lead, and silver, the Tintic Division (Utah) of Kennecott Copper Corp. benefited in 1974 from higher metal prices. The mine continued to operate under adverse conditions including groundwater problems and high temperatures.[16] The Park City mine in Utah, developed as a joint venture between The Anaconda Company and ASARCO, will be ready for production in 1975.

Arizona zinc mine production totaled 9,699 tons in 1974, an increase of 15% over that of 1973. Cyprus Bruce Copper & Zinc Co. owned and operated the Bruce mine near Bagdad. Nearly 93,000 tons of ore was mined with an average grade of 3.86% copper and 13.6% zinc. Proven ore reserves totaled more than 300,000 tons with an average grade of 12.5% zinc and 3.74% copper. At the current mining rate, quantity of ore was adequate for 3 years of operation. Exploration was continuing.[17]

Mine output of zinc from New Mexico increased 12% in 1974 to 13,784 tons. At ASARCO's Ground Hog mine the zinc content of ore produced was 12,400 tons in 1974 compared with 13,500 tons in 1973. Major improvements at the mine included the installation of new trackless equipment which increased productivity and lowered costs.[18]

UV Industries, Inc., continued its exploration program to define additional copper ore in the Central district of New Mexico as well as to evaluate the potential recovery of iron and zinc. All the activity took place in Grant County at the Continental and Hanover mines.[19]

Mine production of zinc in Washington was 6,909 tons in 1974, an increase of 8% over that of 1973. In March, Gulf Resources & Chemical Corp. acquired Pend

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[11] Gulf Resources & Chemical Corp. 1974 Annual Report. P. 11.

[12] Hecla Mining Co. 1974 Annual Report. P. 6–7.

[13] Day Mines, Inc. 1974 Annual Report. P. 4.

[14] Gulf & Western Industries, Inc. 1974 Annual Report. P. 16.

[15] Kerr Addison Mines Ltd. 1974 Annual Report. Pp. 6–7.

[16] Kennecott Copper Corp. 1974 Annual Report. P. 11.

[17] Cyprus Mines Corp. 1974 Annual Report. Pp. 11–12.

[18] Work cited in footnote 7.

[19] UV Industries, Inc. 1974 Annual Report. P. 4.

Oreille Mines and Metals Co.[20] The Bunker Hill Co., a division of Gulf Resources, continued operation of the Pend Oreille mine. Surface drilling continued throughout 1974 at the Washington Zinc Unit of the Callahan Mining Corp. zinc-lead property near Colville, Wash. The program is being managed by Callahan and funded by United States Borax & Chemical Corp. and Brinco Ltd. The zone of known mineralization was increased substantially and an underground program to test the ore potential was underway.[21]

Wisconsin mine production of zinc was 8,737 tons in 1974, an increase of 1% over that of 1973. Production in southern Illinois declined 22% from that of 1973. Production in Kentucky ceased while Nevada, with 3,405 tons, produced zinc for the first time since 1971.

SMELTER AND REFINERY PRODUCTION

U.S. slab zinc production at seven primary plants and six secondary plants was 633,723 short tons in 1974, a decrease of 5% from that of 1973. The decrease may be attributed to the closure of a horizontal retort smelter at the end of 1973 and an overall decline in production. The AMAX electrolytic refinery at Sauget, Ill., more than doubled its production over that of 1973.

Producer stocks increased 10% during the year from 25,947 tons to 39,720 tons. In addition to slab zinc production, the seven participating primary domestic producers purchased 84,685 tons of GSA stockpile zinc during the year; 49,508 tons was shipped directly to their customers, and 35,177 tons was remelted.

Smelter and refinery capacities decreased by 19,000 tons. With the closure of AMAX's Blackwell, Okla., smelter and expansions at the Sauget, Ill., plant, industry capacity stood at 731,000 tons by yearend.

Slab zinc production at the smelter and electrolytic refineries was from domestic ore, 55%; foreign ore, 33%; and scrap, 12%. Zinc produced from foreign sources increased 13% over that of 1973 while that produced from domestic ore and scrap decreased 13% and 6%, respectively.

Primary slab zinc produced at electrolytic refineries increased 7% over that of 1973 and was 36% of the total slab zinc produced. Smelter production (distilled) was down 12% and made up 52% of the total. Redistilled slab zinc from secondary zinc materials at primary smelters decreased 17% and contributed 9% of the total, and redistilled slab zinc at secondary smelters increased 44% and was 3% of the total. Distribution of slab zinc production by grades was Prime Western, 48%; Special High Grade, 44%; Intermediate, 4%; High Grade, 3%; and Brass Special, 1%.

ASARCO proposed building a 180,000-ton-per-year electrolytic zinc plant at Stephensport, Ky., at an estimated cost of $160 million. A contract was awarded in October for design and engineering of the facility. Arrangements for an adequate supply of power were expected to be completed in 1975. The project could come onstream late in 1977. Construction began on a new 350-ton-per-day sulfuric acid plant at the ASARCO electrolytic zinc refinery in Corpus Christi, Tex., and should be completed in 2 years. The new acid plant will replace two existing plants dating back to 1942.

ASARCO's 50-year old, 50,000-ton-per-year horizontal retort smelter at Amarillo, Tex., operated under a Texas Air Control Board variance until May 31, 1975. The plant was scheduled for closing at that time. The ASARCO zinc fuming plant at East Helena, Mont., received extensive modernization in 1974, including construction of a new 350-foot stack to improve dispersion of filtered furnace gases.[22]

AMAX continued the rehabilitation and improvement program of the electrolytic zinc plant at Sauget, Ill. The addition of preleach facilities to process high magnesium-bearing concentrate from Missouri was completed in 1974. Other projects underway will facilitate expansion of production to 84,000 tons of zinc per year by 1976. All operations at the Blackwell, Okla., zinc plant ended in December 1974. The horizontal retort smelter was closed in 1973 but the sinter plant continued production until August 1974 and the cadmium plant continued until December 1974.[23]

St. Joe Minerals Corp., the largest domestic zinc producer, produced 223,968 tons of zinc (zinc equivalent) in 1974, 3% below 1973 production. The decline was due to continuing furnace problems and a slackening in zinc and zinc oxide demand in the fourth quarter which dictated a cutback in the rate of production.[24]

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[20] Page 4 of work cited in footnote 11.

[21] Callahan Mining Corp. 1974 Annual Report Pp. 5–6.

[22] Pages 6 and 9 of work cited in footnote 7.

[23] Work cited in footnote 4.

The New Jersey Zinc Co. planned to construct an electrolytic zinc refinery near Clarksville, Tenn., with production scheduled to begin in 1977. This will be the first new zinc-producing facility to be built in the United States in over 30 years.[25] Projects were underway to increase zinc oxide capacity and improve processing techniques at the Palmerton, Pa., smelter. In addition, expenditures were made to comply with environmental requirements.[26]

The Bunker Hill Co. of Kellogg, Idaho, produced 92,000 tons of zinc in 1974, down from 98,000 tons in 1973. The rated annual capacity of the zinc plant was 109,000 tons. The decline in production during the year resulted from area flooding, interruptions in electrical supply, and a 10-day strike.[27]

On February 11, 1974, Engelhard Minerals & Chemical Corp. consummated the purchase of the assets of National Zinc Co., Inc., which was principally the zinc smelter at Bartlesville, Okla. The plant produced approximately 50,000 tons of zinc metal per year. The company was converting the existing horizontal retort smelter to an electrolytic facility at a cost of $40 million. The new plant was scheduled to be in production in 1976 and will be designed to comply with applicable pollution control laws.[28]

Secondary Zinc Smelters.—Zinc recovered from processing zinc-bearing scrap was 338,482 tons in 1974, a decrease of 12% from that of 1973. Semimanufactured forms and shapes of alloys, primarily zinc- and copper-base alloys, accounted for 98% of the new and old scrap processed. New scrap, chiefly zinc- and copper-base alloys from manufacturers and drosses from galvanizing kettles and diecasting pots accounted for 78% of all the scrap processed. The zinc was recovered in alloys, mostly in brass and bronze, 51%; as zinc-metal, 32%; and in chemical products, 17%.

Slag-Fuming Plants.—Slag fuming plants processed new hot slags, old cold slags, and residues to produce zinc oxide fume. The oxide was sent to smelters and refineries for recovery of zinc or it was sold to consumers as zinc oxide. Three plants operated in 1974 as follows: ASARCO at El Paso, Tex., and East Helena, Mont., and the Bunker Hill Co., at Kellogg, Idaho.

Byproduct Sulfuric Acid.—There were eight plants with facilities for roasting zinc sulfide concentrates. Seven plants produced sulfuric acid and one plant operated solely to produce calcine for processing to zinc oxide or slab zinc. In 1974 production of byproduct sulfuric acid from zinc plants was 830,969 tons, up from 819,537 tons produced in 1973.

Zinc Dust.—Production of zinc dust was 50,775 tons in 1974, down 10% from that of 1973. Zinc dust from scrap accounted for 29,075 tons, 57% of the total zinc dust produced.

CONSUMPTION AND USES

Domestic consumption of slab zinc was 1,287,696 tons in 1974, a decrease of 14% from that of 1973. The zinc content of the ore used directly in galvanizing or compounds was 127,113 tons, down from 129,651 tons in 1973. The zinc content of secondary materials to make alloys, zinc dust, and compounds was 258,204 tons, down from 298,336 tons in 1973. Total consumption of zinc for all classes was 1,673,013 tons, a decrease of 13% from that of 1973.

Zinc consumption was reported by 670 users in 1974. Slab zinc for galvanizing accounted for 523,269 tons (41%); zinc base alloys, 440,259 tons (34%); brass products, 181,563 tons (14%); zinc oxide, 65,376 tons (5%); rolled zinc, 39,393 tons (3%); and other, 37,836 tons (3%). Slab zinc used to produce zinc oxide and for other uses showed gains over those of 1973 while the major end use categories showed considerable decreases.

Slab zinc consumption distributed by grade was Special High Grade, 572,851 tons (45%); High Grade, 153,124 tons

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[24] Work cited in footnote 2.

[25] Chemical Marketing Reporter. Gulf & Western Plans Zinc Units Construction. V. 205, No. 3, July 15, 1974, pp. 3, 21.

[26] Work cited in footnote 14.

[27] Pages 8 and 11 of work cited in footnote 11.

[28] Englehard Minerals & Chemicals Corp. 1974 Annual Report. P. 4.

(12%); Intermediate, 26,345 tons (2%); Brass Special, 122,104 tons (9%); Prime Western, 412,057 tons (32%); and Remelt, 1,215 tons (less than 0.1%). Except for a small increase in Remelt, consumption of all grades of slab zinc decreased from that of 1973. The most significant decline was that in Special High Grade zinc which showed a loss of 166,596 tons. This sharp decrease was attributed to the decline in the diecasting industry primarily due to the slump in automobile production.

Slab zinc consumed at rolling mills was 39,393 tons in 1974, a decrease of 3% from that of 1973. Production of rolled zinc products decreased 7% to 38,417 tons. Strip and foil accounted for 78%, while 17% was used for photoengraving plates. Exports of wrought zinc increased 41% to 3,487 tons but imports more than doubled over those of 1973 to 640 tons. Production of rolled zinc from scrap was 33,474 tons in 1974, yielding a total of 71,891 tons of rolled zinc during the year, compared with 70,202 tons in 1973.

The leading slab zinc consuming States in 1974 were Ohio with 176,819 tons (14%); Illinois, 172,260 tons (13%); Pennsylvania, 166,359 tons (13%); Indiana, 137,178 tons (11%); Michigan, 130,387 tons (10%); and New York, 101,299 tons (8%). These six States accounted for 69% of the slab zinc consumed. Ohio ranked highest in galvanizing and Michigan was the leader in diecasting.

ZINC PIGMENTS AND SALTS

Production.—Published data for zinc pigments and compounds include zinc oxide and zinc sulfate. Information for leaded zinc oxide, lithopone, and zinc chloride was not published in 1971–74 to keep individual company data confidential.

Production of zinc oxide in 1974, 256,355 tons, increased 1.5% over that of 1973. Shipments were 9% lower than production. Zinc sulfate production, 46,135 tons, showed an increase of 5%.

The source of domestic zinc oxide production was 54% from ore and concentrate (American process), 32% from slab zinc (French process), and 14% from secondary material. Zinc sulfate production came from secondary material and from ore or intermediate products. Lead-free oxide was produced by 12 plants in the United States and leaded zinc oxide was produced at only 1 plant. At least eight plants produced zinc sulfate and four produced zinc chloride.

Production of zinc oxide by St. Joe Minerals Corp. was 67,217 tons, reflecting an expansion of production facilities to a capacity of 85,000 tons per year.[30] Two other producers using ores or concentrates as a major source material were ASARCO with plants at Columbus, Ohio, and Hillsboro, Ill., and the New Jersey Zinc Co. Other major zinc oxide producers such as the Eagle-Picher Industries Inc., Hillsboro, Ill., plant and the Sherwin-Williams Co., Coffeyville, Kans., plant, used calcines, fume, and secondary materials as raw materials.

Consumption and Uses.—The apparent consumption of zinc oxide decreased by 10% from about 273,000 tons in 1973 to 246,000 tons in 1974. Analysis of domestic shipments by industry usage showed the rubber industry as consuming 47% of U.S. shipments. Photocopying and chemicals each accounted for 15% of the total. Use of zinc oxide in ceramics, chemicals, and agriculture increased. The rubber industry consumed 16% less in 1974 as the automotive industry experienced declining sales. Agriculture was the chief use for zinc sulfate with lesser amounts going for rayon, flotation reagents, and chemicals. The use of leaded zinc oxide in rubber increased during 1974, but its use in paints declined substantially. Zinc chloride usage, a small part of zinc compound consumption, declined.

Prices.—Zinc oxide and compound prices tended to follow increases in the price of zinc metal. At the beginning of 1974, prices ranged from 22.5 cents per pound for American process zinc oxide to 34.5 cents for French process and to 39.75 cents for electrophotographic grade. On March 14 zinc prices increased 3 cents, after which three companies increased oxide prices by about the same amount. Zinc oxide prices in April steadied at the higher end of the range after the March increase. In July prices again advanced to 37.5 to 41 cents for American process, 39 to 42.5 cents for French process, and 40.5 to 44 cents for electrophotographic grade. Prices climbed slowly for the remainder of the year. At the end of the year most quotations ranged from 40 cents for American process lead-free pigment grade to 41.5 cents for French process and 42 to 44 cents for electrophotographic grade. At yearend leaded zinc oxide, 12%, was quoted at 37.25 cents per pound compared with 30.25 cents in January 1974. The price of zinc sulfate, granular monohydrate industrial, 36% zinc, bags in car load lots, was reported as $24 per 100 pounds in December, up from $18.50 per 100 pounds a year earlier.

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[30] Work cited in footnote 2.

Foreign Trade.—Exports of zinc oxide increased by 73% during 1974 to a record 12,245 tons, with Canada and Japan receiving about half the total. Lithopone exports increased by 20% to 1,185 tons. Imports of almost all classes of zinc compounds increased in 1974 to a total of 39,436 tons, a 7% gain. As in 1973, zinc oxide, although it declined 6% to 26,088 tons, was the major component of imports of zinc compounds. Mexico, Canada, and France were major sources with other European Community countries contributing small tonnages.

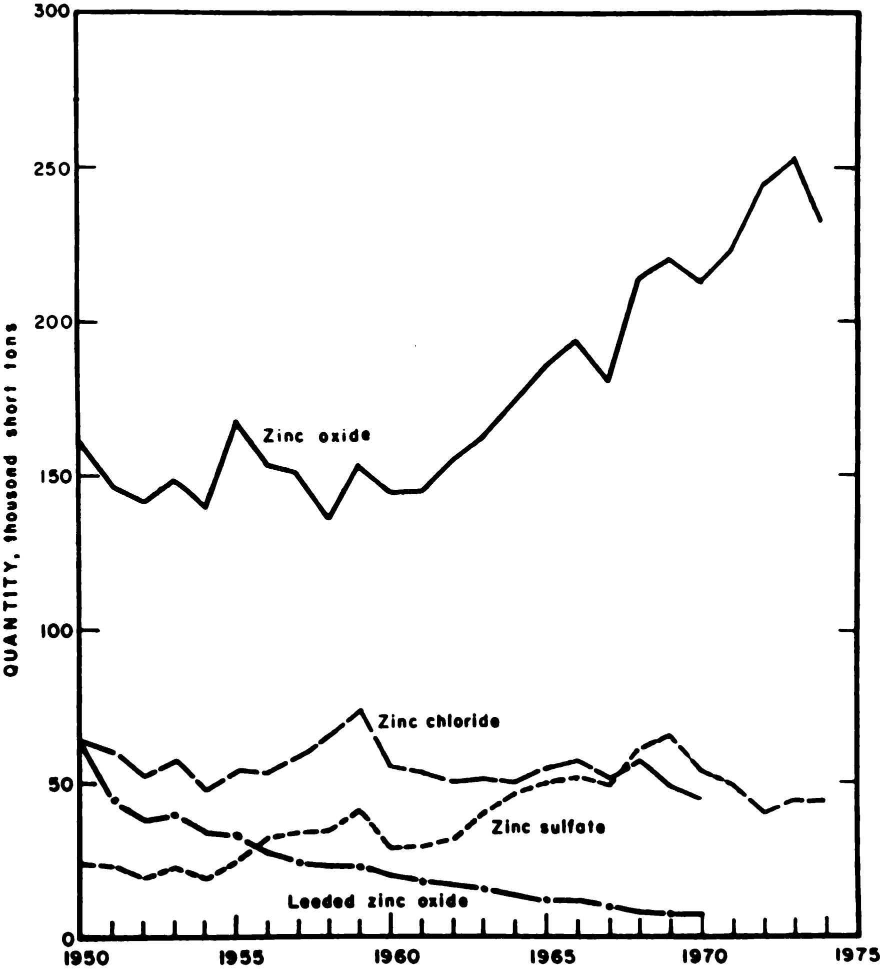

Figure 4.—Trends in shipment of zinc pigments.

STOCKS

Producer Stocks.—Stocks of slab zinc at producer plants at the beginning of the year were 25,947 tons and at yearend were 39,720 tons. The Zinc Institute, Inc., reported that producer stocks were at low levels from May through October.

Consumer Stocks.—Slab zinc inventories at consumer plants were 114,317 tons at the beginning of the year, and by yearend consumer stocks reached a record high of 210,749 tons. Prime Western zinc stocks accounted for the largest increase.

Government Stockpile.—During 1974 the GSA inventory was reduced from 677,009 tons to 391,600 tons.

PRICES

The price for domestic Prime Western zinc ranged from 28 to 32 cents per pound at the beginning of 1974, and the price for Special High Grade zinc ranged from 28.5 to 33.5 cents per pound. Prices increased steadily during the first half of the year. The price for Special High Grade zinc reached 39 to 41.5 cents per pound in July, and that of Prime Western zinc reached 38 to 40 cents per pound in September. These prices remained unchanged through December. Producer prices were quoted f.o.b. smelter or delivered.

The U.S. dealer price for Special High Grade zinc ranged from 75 to 82 cents per pound at the beginning of the year. After a decline, a turnaround took place in late February with steady increases until the price peaked in May at 85 to 87 cents per pound. Prices fell again so that by October the U.S. dealer price was less than the domestic producer price. By yearend U.S. dealer Special High Grade zinc was sold for 34 to 35 cents per pound.

The foreign producers, especially Canada, Peru, and Australia, experienced price increases similar to that of the domestic producers. At the beginning of the year, imported zinc (Prime Western equivalent) was 31 to 36.5 cents per pound. The price increased to a high of 38.3 to 42.5 cents per pound in September. The low side of 38.3 cents per pound remained unchanged but the high side dropped to 39 cents per pound in December.

The European producer price for Good Ordinary Brand (GOB) zinc (Prime Western equivalent) was £300 per metric ton (31.1 cents per pound U.S. equivalent) at the first of the year. The price increased in March to £330 per metric ton and finally to £360 per metric ton (38 cents per pound) in September.

The London Metal Exchange (LME) price for zinc started at £587 to £590 per metric ton (61.3 to 61.7 cents per pound). This price followed the U.S. dealer price with a price drop at the first of the year followed by a gradual increase until May, when it reached £872 to £875 per metric ton (96.3 to 96.6 cents per pound). The trend was reversed once again with a gradual decrease to £300 to £301 per metric ton (31.9 to 32 cents per pound) at yearend.

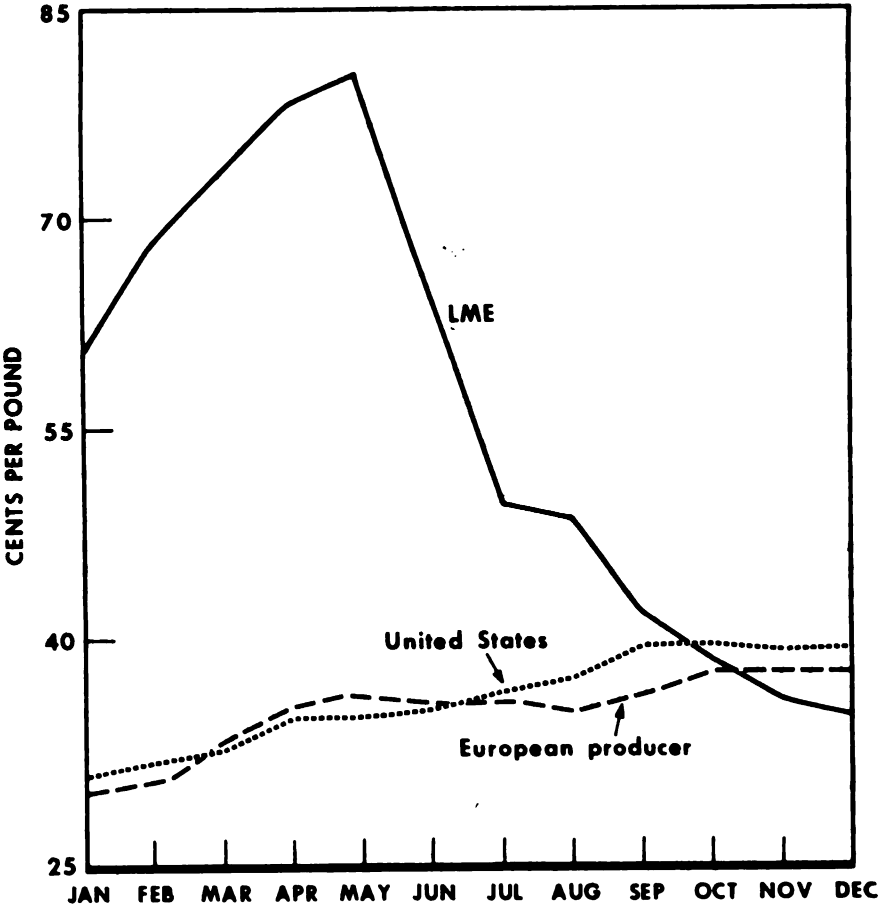

Figure 5.—Average monthly prices in 1974 for U.S. Prime Western zinc and equivalent foreign grade.

FOREIGN TRADE

Exports of unwrought zinc and alloys were 37,927 tons in 1974, a 51% increase over that of 1973. Brazil received 24% of the exports; Belgium-Luxembourg, 12%; the Netherlands, 9%; and Venezuela; 8%. Wrought zinc and zinc alloy exports were 13,078 tons in 1974, of which 39% went to Belgium-Luxembourg and 28% to Canada.

General imports of zinc in ore were 240,043 tons in 1974, an increase of 20% over that of 1973. Canada supplied 68% and Mexico 10%. General imports of zinc metal were 539,538 tons, a decrease of 9% from that of 1973. Canada supplied 270,156 tons, 50% of the total. Other leading suppliers were Japan, Australia, Peru, and Belgium-Luxembourg.

Imports of ore for consumption were 133,733 tons in 1974, a decrease of 13% from that of 1973. The imports for consumption of ore was less than general imports of ore, suggesting a continuing trend of stock buildup of ore at the bonded warehouses. Metal imports for consumption were 543,806 tons in 1974, 1% more than general imports of metal. Metal imports again exceeded the quantity of zinc in imported ores and concentrates. This trend was established 3 years ago with the decline of U.S.-smelter capacity.

There were no changes in the basic tariff rates in 1974. The duty on various zinc materials was as follows: Slab zinc, 0.7 cent per pound; zinc ores, concentrates, and fume, 0.67 cent per pound (based on zinc content less allowable deductions for processing losses); zinc scrap (including skimmings and drosses) 0.75 cent per pound; and zinc dust, 0.3 cent per pound. The duty rate for unwrought alloys of zinc, which includes diecasting alloys was 19% ad valorem.

WORLD REVIEW

Australia.—Mount Isa Mines Ltd. (MIM) postponed startup of its Hilton mine until 1978–79 because delineating of the reserves is expected to take another 4 or 5 years. MIM planned a 50-ton-per-day pilot plant to investigate the McArthur River lead-zinc prospect. The physical properties of the ore have presented metallurgical problems. EZ Industries, Ltd., began mining at Beltana, South Australia. The deposit contains 1 million tons of ore averaging 34.5% zinc and another 237,000 tons averaging 14.8% zinc; the willemite ore required development of new processing methods.

Bolivia.—The New Jersey Zinc Co. announced plans to develop the Huari-Hauri mine northwest of Potosí with an annual output of about 55,000 tons of zinc. The company plans to spend $4 million on the mine and a new flotation mill. The Bolivian Government proposed building an 85,000-ton-per-year zinc smelter at a cost of $50 million. The plant will be strategically located between the northern and southern zinc mining areas.

Canada.—Canada led the world in zinc mine production with 1.28 million tons, a 5.5% decrease from that of 1973. While the Ruttan mine of Sherritt Gordon Mines Ltd., and the Buchans mine of ASARCO registered significantly higher production, seven major mines showed substantial declines in production. The Brunswick Mining & Smelting Corp., Ltd., the Sullivan and H.B. mines of Cominco Ltd., Cyprus Anvil Mining Corp., and Pine Point Mines, Ltd. had decreased output because of labor problems. Lower ore grade led to decreased output by Texasgulf Canada Ltd. (formerly Ecstall Mining, Ltd.) and Mattabi Mines Ltd. Twenty other mines produced at rates about equal to or lower than those of 1973. Ontario was the leading producing province with 36% of the total, followed by Northwest Territories, 15%; New Brunswick, 14%; and Quebec, 11%. Japan, Belgium-Luxembourg, and the United States, all importing about equal amounts, were the leading buyers of Canadian ores and concentrates. Canadian consumption of zinc was about 173,000 tons in 1974, 24% above that of 1973.[30] Canadian smelter production, at 470,000 tons, was 20% less than that of 1973, reflecting losses due to labor strikes and the general shortage of concentrate. Smelter expansions completed or underway in 1974 will raise capacity to 760,000 tons of metal per year.

In Newfoundland, ASARCO produced zinc concentrates from the Buchans mine. The 1,250-ton-per-day mill operated 5 days per week; ore reserves of about 1.5 million tons were expected to last 5 years. Newfoundland Zinc Mines, Ltd., expected to begin production at its Daniel's Harbor mine late in 1975. Annual production of 44,000 tons of zinc in concentrate will come from reserves estimated at 4.5 million tons assaying 8.8% zinc. Noranda Mines Ltd. will purchase about two-thirds of the concentrate.

Imperial Oil Ltd. and Cuvier Mines Ltd. continued exploration work at the Gays River deposit in Nova Scotia. Indications were that ore reserves may be in the 15- to 20-million-ton-range assaying 2% to 3% lead and 5% to 6% zinc.

Because of labor problems, production by Brunswick Mining & Smelting Corp., Ltd., from its mine in Bathurst, New Brunswick, was much lower in 1974. An expansion program at the No. 12 mine is expected to increase capacity to 11,000 tons of ore per day, and the capacity of the No. 12 mill will be increased above its present capacity of 9,800 tons per day. By 1977 the company plans to cease operations at its No. 6 open pit mine, a 3,600-ton-per-day operation. Reserves at the No. 12 mine were about 87 million tons assaying 9.3% zinc and 3.9% lead.[31]

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[30] Barry, G. S. Zinc: Producers Could Avert Oversupply. Can. Min. J., v. 96, No. 2, February 1975, pp. 81–95.

The expansion program of Heath Steele Mines Ltd. at Little River was about 60% complete. Reserves of 37 million tons contained 4.4% zinc, 1.6% lead, 1.2% copper, and 1.7 ounces of silver per ton. Nigadoo River Mines Ltd., 96.1% controlled by the Sullivan Mining Group, reopened its Beresford mine in February. Mill capacity was being increased to 1,200 tons of ore per day.

Mattagami Lake Mines Ltd., the largest producer in Quebec, installed a new mill and a computerized system for the flotation circuits. Of the zinc concentrate produced, 74% was treated at the Canadian Electrolytic Zinc Ltd. (CEZ) smelter at Valleyfield, 1.5% went to the United States and 24.5% was exported to other countries.[32] Kerr-Addison Mines Ltd. continued to treat ore from the Normetal and Joutel mines, producing 9,661 tons and 5,186 tons of zinc in concentrate, respectively. The Normetal mine continued to operate because of higher metal prices and stable operating costs.[33] Orchan Mines Ltd. treated 364,030 tons of ore including 219,865 tons averaging 6.96% zinc from the main mine and 144,165 tons averaging 1.47% zinc from the new Garon Lake mine. The Norita Division, with reserves of 1.6 million tons grading 7.6% zinc and 0.7% copper, planned to open its mine in 1976.[34]

Other principal zinc producers were Falconbridge Copper Ltd., Manitou-Barvue Mines Ltd., and the Sullivan Mining Group Ltd. In exploration, Selco Mining Corp., and Pickands Mather & Co., uncovered a copper-zinc find in Brouillan township; Noranda bought the Magusi copper-zinc property in Hebecourt township and may be in production by 1979; Patino Mines Ltd. delineated a 625,000-ton ore body assaying 10.8% zinc near Chibougamau; and Abcourt Metals Inc. examined the possibility of mining its zinc-silver deposits in Baurraute township.

Production from the Kidd Creek mine in Timmins, Ontario operated by Texasgulf Canada Ltd. was about 302,000 tons of zinc in concentrate. Metal production was 107,900 tons from the new zinc plant which was operating at its design level of 120,000 tons of metal per year by year-end.[35] The mine and mill complex of Sturgeon Lake Mines Ltd. and Falconbridge Nickel Mines Ltd. was completed. The ore grade averaged 2.1% copper, 7.6% zinc, and 1.1% lead. Ore reserves were estimated to be 2.2 million tons averaging 10.2% zinc, 1.4% lead, 2.8% copper, and 5.8 ounces of silver per ton.[36]

Mattabi Mines Ltd. milled 1.14 million tons of ore grading 8.8% zinc, 0.9% copper, and 0.9% lead. Ore reserves were placed at 11.1 million tons assaying 6.5% zinc. Mattagami Lake Mines Ltd. reported reserves at its soon-to-be-opened Lyon Lake property at 3.1 million tons averaging 6.2% zinc, 1.2% copper, and 0.6% lead.[37] Selco Mining Corp. extended the life of its South Bay mine with the development of a new ore zone.

In Manitoba, the Hudson Bay Mining & Smelting Co. Ltd., reported proven reserves of copper-zinc-ore in the Flin Flon-Snow Lake area at almost 18 million tons assaying 2.7% zinc. Ore production from nine mines was 1.6 million tons. Another mine, the Centennial, was under development. The refinery produced 78,000 tons of Special High Grade zinc. This was the first year that the concentrate feed contained more custom material than company material. Sherritt Gordon Mines Ltd. increased its zinc production through the full-year operation of the Ruttan mine and improved output at the Fox mine. A substantial portion of concentrate production was treated in Manitoba. Production from the two mines was 39,600 tons of zinc in concentrate.[38]

In British Columbia mine production decreased 39% because of a lengthy strike at the Sullivan and H.B. mines of Cominco Ltd. Lower grade ore was mined at the Western Mines Ltd. Buttle Lake mine. The company was considering closing its

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[31] Noranda Mines Ltd. 1974 Annual Report. Pp. 20–21.

[32] Mattagami Lake Mines Ltd. 1974 Annual Report. P. 8.

[33] Page 5 of work cited in footnote 15.

[34] Page 86 of work cited in footnote 30.

[35] Texasgulf Inc. 1974 Annual Report. Pp. 10–11, 14.

[36] Falconbridge Nickel Mines Ltd. 1974 Annual Report. P. 35.

[37] Page 23 of work cited in footnote 32.

[38] Sherritt Gordon Mines Ltd. 1974 Annual Report. Pp. 7–9.

Myra Falls mine because of new taxes and low prices. Reeves MacDonald Mines Ltd. produced at a somewhat higher level than in 1973 and reported finding more ore reserves. Other developments included an attempt by Consolidated Columbia River Mines to reopen the Ruth Vermont mine if financing can be arranged; Zaballos Development Company Ltd. outlined 100,000 tons of ore assaying 12.5% zinc; Dolly Varden Mines Ltd. contemplated startup of a 1,000-ton-per-day mine near Alice Arm; and Northair Mines Ltd. scheduled production at its gold-zinc-lead deposit to begin by yearend 1975 at the rate of 300 tons per day.

In the Yukon Territory, Anvil Mining Corp. Ltd. experienced lower production because of labor and transportation problems. The shortage of experienced miners led to lower production by United Keno Hill Mines Ltd. Exploration was very active as Kerr Addison Mines Ltd. and Aex Minerals Corp. discovered a major zinc-lead-silver deposit near Vangorda Creek. There was widespread interest in the Bonnet Plume area where Barrier Reef Resources Ltd. showed 1 million tons grading over 15% zinc, and Placer Development Ltd. continued its activity at Summit Lake.

In the Northwest Territories, Pine Point Mines Ltd. produced at about the 1973 level and began production from the Coronet deposits. Reserves at its Conwest property were about 1.4 million tons grading 9.6% zinc. Nanisivik Mines Ltd., 59.5% owned by Mineral Resources International Ltd., 18.0% by the Canadian Government, and 11.25% each by Metallgesellschaft A.G. of West Germany and Billiton N.V. of the Netherlands, expected to open a lead-zinc mine on Strathcona Sound on Baffin Island. Reserves were estimated at 6.9 million tons containing 14.1% zinc, 1.4% lead, and 1.77 ounces of silver per ton. Production, possibly beginning late in 1976, was expected to be at a rate of 1,500 tons per day.

Denmark.—The Black Angel mine in Greenland, operated by Greenex, A/S, produced 635,000 tons of ore in its first full year of operation. Production of zinc concentrate, which contains small quantities of cadmium and silver, was 185,000 tons. Most of the zinc was sold as concentrate, while the remainder was toll-smelted. Exploration work continued on the development of the Cover ore zone.

Ireland.—Tara Exploration and Development Co. Ltd., deferred development of its Navan lead-zinc ore body as a consequence of the refusal of the Ministry of Industry and Commerce to grant it a mining license that was acceptable to Tara. Tara said it would begin legal proceedings to protect its stockholders and seek damages. According to the company, since 1970 it has invested $38 million at the site, and possibly would have spent another $100 million to bring the mine into full production of about 470,000 tons of concentrate per year. When work was suspended in August, the development shaft had been completed to a depth of 1,122 feet, and over 95,000 tons of ore averaging 11.4% zinc and 2.4% lead had been stockpiled on the surface. Work had commenced on the concentrator and engineering on the process plant was about three-fourths complete. About $5 million was allocated to protection of the local environment.[39]

Mogul of Ireland, Ltd., milled 914,280 tons of ore grading 2.36% lead and 6.58% zinc. Although lower grade ore was treated, concentrate grades improved significantly.[40]

Japan.—Metal production increased 7% as the expanded Iijima smelter of Akita Zinc Co. Ltd. came onstream in September at its full capacity of 170,000 tons per year. Mitsui Mining & Smelting Co. Ltd. struck a rich ore body containing 11% zinc in the Mozumi pit at its Kamioka mine. Proven reserves were estimated at 7.2 million tons with an additional probable reserve of 5 million tons averaging 7.7% zinc. The production rate at the Mozumi pit was 1,600 tons of ore per day.

Mexico.—Industrial Minera Mexico, S.A. (formerly Asarco Mexicana, S.A.) planned to commit a major share of its $160 million investment for integration of its zinc operations. The company slated $96 million for a 121,000-ton-per-year electrolytic zinc refinery to be completed in 1976 at San Luis Potosí. This new capacity would bring Mexico's zinc refining capacity to 330,000 tons per year, or about the equivalent of mine production. Industrial Minera also installed a new mill at its Taxco silver-lead-zinc mine to increase production to 2,400 tons per day. At the San Martín mine in Zacatecas, facilities were being expanded to double production of silver, zinc, and copper by 1976. Two other mines at Pitiquito and Velardeña were scheduled to begin production in 1976.

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[39] Tara Exploration and Development Company Ltd. 1974 Annual Report. Pp. 5–15.

[40] International Mogul Mines Ltd. 1974 Annual Report. P. 3.

The 115,000-ton-per-year electrolytic zinc smelter at Torreón came onstream. The plant cost $72 million including $12 million for pollution control equipment.

Peru.—Output from the Madrigal mine, operated by Compañía Minera del Madrigal, in which Homestake Mining Co. has an interest, was 14,601 tons of zinc concentrate compared with 11,698 tons in 1973. The copper, lead, and zinc concentrates were sold to Japanese smelters. Compañía Minerales Santander, Inc., a subsidiary of St. Joe Minerals Corp., produced 67,478 tons of zinc concentrate for export, down from 69,725 tons in 1973.

Minero Peru selected a site at Cajamarquilla for a new electrolytic smelter with an annual capacity of 110,000 tons of zinc. The $90 million dollar facility is expected to come onstream in 1978. The plant will treat 175,000 tons of 53% zinc concentrate per year.

Poland.—The Pomorzan mine, reportedly one of the largest lead-zinc mines in Europe, came onstream. The production rate was 650 tons of ore per day with a tripling expected after 2 years of operation. Licensing was granted for the expansion of the Imperial-type smelter at Miasteczko Slaskie. The new unit will replace three horizontal retort smelters in the Katowice area.

Spain.—Cominco Ltd. of Canada planned the development of a lead-zinc mine on the Rubiales property in northwestern Spain at a cost of $43 million. The mine and concentrator were expected to be producing, on an annual basis, 127,000 tons of zinc concentrate and 17,000 tons of lead concentrate from 800,000 tons of ore by mid-1977. Reserves on the property total 7.5 million tons assaying 9.9% zinc and 1.7% lead. The zinc concentrates will be sold to Asturiana de Zinc S.A. for smelting in Spain.

Thailand.—Thai Zinc Co. Ltd., 90% owned by the New Jersey Zinc Co., opened the Mae Sot mine in Tak Province in March. About 80,000 tons of zinc ore was mined in its first 6 months of operation. The company will ship the zinc silicate ore to its pilot plant at Palmerton, Pa., before constructing a 66,000-ton-per-year smelter adjacent to the mine site at a cost of $87 million.

TECHNOLOGY

Bureau of Mines research on zinc was underway at three locations. At the Reno Metallurgy Research Center studies focused on the extraction of zinc as a chloride and its recovery by fused salt electrolysis. A chlorine-oxygen leach was used to recover metal values from complex sulfide concentrates which cannot readily be processed by smelting. In the process most of the sulfide is discarded with the tailings as elemental sulfur. The anhydrous zinc chloride product, after recovery of byproducts, is electrolyzed to yield high purity metal. At the Rolla Metallurgy Research Center a continuous process furnace was tested for recovering slab zinc or powder from zinc oxide contained in flue dusts, and work continued on hydrometallurgical processes for recovering zinc and elemental sulfur from sphalerite concentrates. Researchers at the Salt Lake City Metallurgy Research Center studied cryogenic techniques for the recovery of zinc from the nonferrous fraction of auto scrap.

Results of several research investigations were published by the Bureau of Mines.[41]

The International Lead Zinc Research Organization, Inc. (ILZRO) supported numerous projects in 1974, especially in diecasting, plating, galvanizing, and chemical uses and sponsored several international conferences. Progress reports of these projects are released annually by means of the ILZRO Research Digest.

A comprehensive coverage of zinc-related investigations and an extensive review of current world literature on the uses of zinc and its products are contained in bimonthly issues of the 1974 Zinc Abstracts published by the Zinc Institute, Inc., 292 Madison Avenue, New York, N.Y. 10017, and provided free of charge.

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[41] Carillo, F. V., M. H. Hibpshman, and R. D. Rosenkranz. Recovery of Secondary Copper and Zinc in the United States. BuMines IC 8622, 1974, 58 pp.

Dressel, W. M., P. G. Barrard, and M. M. Fine. Removal of Lead and Zinc and the Production of Prereduced Pellets From Iron and Steelmaking Wastes. BuMines RI 7927, 1974, 15 pp.

Fukubayashi, H. H., T. J. O'Keefe, and W. C. Clinton. Effects of Impurities and Additives on the Electrowinning of Zinc. BuMines RI 7966, 1974, 26 pp.

Table 2.—Mine production of recoverable zinc in the United States, by State
(Short tons)

State	1970	1971	1972	1973	1974
Arizona	9,618	7,761	10,111	8,427	9,699
California	3,514	3,003	1,202	20	8
Colorado	56,694	61,181	63,801	58,339	49,489
Idaho	41,052	45,078	38,647	46,107	39,469
Illinois	16,797	12,706	11,378	5,250	4,104
Kansas	1,186	--	--	--	--
Kentucky	4,189	5,268	1,780	273	--
Maine	9,114	5,850	5,820	19,640	10,425
Missouri	50,721	48,215	61,923	82,350	91,987
Montana	1,457	361	12	73	136
Nevada	127	71	--	--	3,405
New Jersey	28,683	29,977	38,096	33,027	32,848
New Mexico	16,601	13,959	12,735	12,327	13,784
New York	58,577	63,420	60,749	81,455	93,077
Pennsylvania	29,554	27,438	18,344	18,857	20,288
South Dakota	1	--	--	--	--
Tennessee	118,260	119,295	101,722	64,172	85,671
Utah	34,688	25,701	21,853	16,800	12,619
Virginia	18,063	16,829	16,789	16,683	17,195
Washington	11,956	5,782	6,483	6,378	6,909
Wisconsin	20,634	10,645	6,873	8,672	8,737
Other States	2,650	3	--	--	23
Total	534,136	502,543	478,318	478,850	[1] 499,872

[1] Data do not add to total shown because of independent rounding.

Table 3.—Mine production of recoverable zinc in the United States, by month
(Short tons)

Month	1973	1974	Month	1973	1974
January	40,807	43,051	August	40,911	41,499
February	36,881	39,597	September	42,721	39,968
March	39,218	42,236	October	43,275	43,751
April	37,204	40,638	November	41,006	41,832
May	40,086	41,162	December	38,656	41,589
June	37,731	42,915			
July	40,354	41,635	Total	478,850	[1] 499,872

[1] Data do not add to total shown because of independent rounding.

Table 4.—Production of zinc and lead in the United States in 1974, by State and class of ore, from old tailings, etc., in terms of recoverable metals
(Short tons)

State	Zinc ore			Lead ore			Zinc-lead ore		
	Gross weight (dry basis)	Zinc content	Lead content	Gross weight (dry basis)	Zinc content	Lead content	Gross weight (dry basis)	Zinc content	Lead content
Arizona	667	47	--	712	1	32	4,903	941	546
California	--	--	--	217	--	25	800	5	1
Colorado	195,563	17,213	2,143	3,110	--	34	464,300	21,885	12,653
Idaho	10,021	437	10	190,000	1,607	18,446	1,037,704	36,853	32,404
Illinois	--	--	--	--	--	--	--	--	--
Maine	206,404	10,425	279	--	--	--	--	--	--
Missouri	--	--	--	9,110,057	91,987	562,097	--	--	--
Montana	792	26	4	289	6	34	200	6	5
Nevada	50	1	--	2,270	10	47	301,688	3,893	1,725
New Jersey	196,499	32,848	--	--	--	--	--	--	--
New Mexico	163,657	13,262	2,120	16	--	2	9,713	292	242
New York	1,231,833	93,077	3,076	--	--	--	--	--	--
Pennsylvania	415,568	20,288	--	--	--	--	--	--	--
Tennessee	3,093,382	82,182	--	--	--	--	--	--	--
Utah	--	--	--	--	--	--	163,022	12,617	10,509
Virginia	619,760	17,195	3,106	--	--	--	--	--	--
Washington	5,000	107	1	--	--	--	(1)	(1)	(1)
Wisconsin	448,652	8,787	1,285	--	--	--	--	--	--
Other States	--	--	--	--	--	--	--	--	--
Total	6,587,848	295,845	12,024	9,306,671	93,611	580,717	1,982,330	75,492	58,085
Percent of total zinc-lead	--	59	2	--	19	87	--	15	9

	Copper-zinc, copper-lead and copper-zinc-lead ores			All other sources [2]			Total		
	Gross weight (dry basis)	Zinc content	Lead content	Gross weight (dry basis)	Zinc content	Lead content	Gross weight (dry basis)	Zinc content	Lead content
Arizona	92,820	8,691	35	59,384,767	19	446	59,483,869	9,699	1,059
California	--	--	--	4,474	3	9	5,491	8	35
Colorado	396,600	10,173	8,269	129,263	718	1,510	1,188,836	49,489	24,609
Idaho	--	--	--	440,576	572	857	1,678,301	39,469	51,717
Illinois	--	--	--	--	4,104	493	--	4,104	493
Maine	--	--	--	--	--	--	206,404	10,425	279
Missouri	--	--	--	--	--	--	9,110,057	91,987	562,097
Montana	12	1	1	21,177	97	110	22,470	136	154
Nevada	--	--	--	1,730,997	1	13	2,035,005	3,405	1,785
New Jersey	--	--	--	--	--	--	196,499	32,848	--
New Mexico	--	--	--	3,318,859	230	--	3,497,245	13,784	2,364
New York	--	--	--	--	--	--	1,231,833	93,077	3,076
Pennsylvania	--	--	--	--	--	--	415,568	20,288	--
Tennessee	1,153,035	3,489	--	--	--	--	4,246,417	85,671	--
Utah	--	--	--	29	2	1	163,051	12,619	10,510
Virginia	--	--	--	--	--	--	619,760	17,195	3,106
Washington	--	--	--	[1]270,476	[1]6,802	[1]1,298	275,476	6,909	1,299
Wisconsin	--	--	--	--	--	--	443,652	8,737	1,285
Other States	--	--	--	6,198	23	2	6,198	23	2
Total	1,642,467	22,354	8,305	65,306,816	12,571	4,739	84,826,132	[3]499,872	663,870
Percent of total zinc-lead	--	4	1	--	3	1	--	100	100

[1] Zinc-lead ore, and ore from "other sources" combined to avoid disclosing individual company confidential data.

[2] Lead and zinc recovered from copper, gold, silver, and fluorspar ores, and from mill tailings and miscellaneous cleanups.

[3] Data do not add to total shown because of independent rounding.

Table 5.—Twenty-five leading zinc-producing mines in the United States in 1974 in order of output

Rank	Mine	County and State	Operator	Source of zinc
1	Balmat	St. Lawrence, N.Y	St. Joe Minerals Corp	Zinc ore.
2	Buick	Iron, Mo	AMAX Lead Co. of Mo	Lead ore.
3	Sterling	Sussex, N.J	New Jersey Zinc Co	Zinc ore.
4	Bunker Hill	Shoshone, Idaho	Bunker Hill Co	Lead-zinc ore.
5	Young	Jefferson, Tenn	American Smelting and Refining Company.	Zinc ore.
6	Friedensville	Lehigh, Pa	New Jersey Zinc Co	Do.
7	Zinc Mine Works	Jefferson, Tenn	United States Steel Corp	Do.
8	Eagle	Eagle, Colo	New Jersey Zinc Co	Do.
9	Austinville and Ivanhoe.	Wythe, Va	do	Do.
10	New Market	Jefferson, Tenn	American Smelting and Refining Company.	Do.
11	Immel	Knox, Tenn	do	Do.
12	Star Unit	Shoshone, Idaho	Bunker Hill Co. and Hecla Mining Co.	Lead-zinc ore.
13	Burgin	Utah, Utah	Kennecott Copper Corp	Do.
14	Leadville	Lake, Colo	American Smelting and Refining Company.	Do.
15	Ground Hog	Grant, N. Mex	do	Do.
16	Blue Hill	Hancock, Maine	Kerramerican Inc	Zinc ore.
17	Idarado	Ouray, and San Miguel, Colo.	Idarado Mining Co	Copper-lead-zinc ore.
18	Edwards	St. Lawrence, N. Y	St. Joe Minerals Corp	Zinc ore.
19	Jefferson City	Jefferson, Tenn	New Jersey Zinc Co	Do.
20	Bruce	Yavapai, Ariz	Cyprus Mines Corp	Copper-zinc ore.
21	Brushy Creek	Reynolds, Mo	St. Joe Minerals Corp	Lead ore.
22	Magmont	Iron, Mo	Cominco American Inc	Do.
23	Viburnum No. 29	Washington, Mo	St. Joe Minerals Corp	Do.
24	Pend Oreille	Pend Oreille, Wash	Pend Oreille Mines & Metals Co., and Bunker Hill Co.	Lead-zinc ore.
25	Sunnyside	San Juan, Colo	Standard Metals Corp	Do.

Table 6.—Primary and redistilled secondary slab zinc produced in the United States[1]

(Short tons)

	1970	1971	1972	1973 r	1974
Primary:					
From domestic ores	403,953	403,750	400,969	399,119	346,993
From foreign ores	473,858	362,683	232,211	184,360	208,195
Total	877,811	766,433	633,180	583,479	555,188
Redistilled secondary	77,156	80,923	73,718	83,187	78,535
Total (excludes zinc recovered by remelting)	954,967	847,356	706,898	666,666	633,723

r Revised.

[1] Excludes processed GSA stockpile zinc.

Table 7.—Distilled and electrolytic zinc, primary and secondary, produced in the United States, by method of reduction

(Short tons)

Method of reduction	1970	1971	1972	1973 r	1974
Electrolytic primary	393,280	321,517	259,816	211,921	227,430
Distilled	484,531	444,916	373,364	371,558	327,758
Redistilled secondary:					
At primary smelters	65,776	68,612	63,034	67,758	56,342
At secondary smelters	11,380	12,311	10,684	15,429	22,193
Total	954,967	847,356	706,898	666,666	633,723

r Revised.

Table 8.—Distilled and electrolytic zinc, primary and secondary, produced in the United States, by grade
(Short tons)

Grade	1970	1971	1972	1973	1974
Special High	401,273	367,609	310,074	r 275,665	277,024
High	109,025	73,314	44,782	25,900	16,912
Intermediate	52,480	58,240	43,353	38,239	22,818
Brass Special	71,811	71,100	76,954	60,034	9,694
Prime Western	320,378	277,098	231,735	r 266,828	307,275
Total	954,967	847,356	706,898	r 666,666	633,723

r Revised.

Table 9.—Primary slab zinc produced in the United States, by State where smelted
(Short tons)

State	1970	1971	1972	1973	1974
Idaho	95,637	94,012	101,743	98,321	92,321
Illinois	110,835	46,389	--	r 26,616	55,527
Montana	148,697	115,480	69,754	--	--
Oklahoma	124,811	126,908	114,162	r 77,819	43,187
Pennsylvania [1]	222,096	228,651	210,860	r 250,752	240,891
Texas	175,735	154,993	136,661	r 129,971	123,262
Total	877,811	766,433	633,180	r 583,479	555,188

r Revised.
[1] Prior to 1972, included West Virginia.

Table 10.—Primary slab zinc plants in the United States in 1974

Type of plant	Plant location	Slab zinc capacity (short tons)
Electrolytic plants:		
Amax Zinc Co., Inc	Sauget, Ill	293,000
American Smelting and Refining Company	Corpus Christi, Tex	
Bunker Hill Co	Kellogg, Idaho	
Horizontal-retort plants:		
American Smelting and Refining Company	Amarillo, Tex	438,000
National Zinc Co., Inc	Bartlesville, Okla	
Vertical-retort plants:		
New Jersey Zinc Co	Palmerton, Pa	
St. Joe Minerals Corp	Josephtown, Pa	

Table 11.—Secondary slab zinc plants in the United States in 1974

Company	Plant location	Slab zinc capacity (short tons)
W. J. Bullock, Inc	Fairfield, Ala	48,500
Gulf Reduction Co	Houston, Tex	
Hugo-Neu-Proler Co	Terminal Island, Calif	
Pacific Smelting Co	Torrence, Calif	
Proler International	Houston, Tex	
Prolerized-Schiabo-Neu Co	Jersey City, N.J	

Table 12.—Stocks and consumption of new and old zinc scrap in the United States in 1974

(Short tons, gross weight)

Class of consumer and type of scrap	Stocks Jan. 1[1]	Receipts	Consumption			Stocks Dec. 31
			New scrap	Old scrap	Total	
Smelters and distillers:						
New clippings	47	719	673	--	673	93
Old zinc	506	6,027	--	6,109	6,109	424
Engravers' plates	145	1,145	--	1,104	1,104	186
Skimmings and ashes	6,065	64,238	61,709	--	61,709	8,594
Sal skimmings	823	204	411	--	411	116
Die-cast skimmings	2,207	8,021	7,026	--	7,026	3,202
Galvanizers' dross	12,896	54,059	53,087	--	53,087	13,868
Diecastings	3,477	48,722	--	46,607	46,607	5,592
Rod and die scrap	31	3,089	--	3,062	3,062	58
Flue dust	937	5,018	5,428	--	5,428	527
Chemical residues	--	10,070	10,069	--	10,069	1
Total	26,684	201,312	138,403	56,882	195,285	32,661
Chemical plant, foundries, and other manufacturers:						
New clippings	2	3	4	--	4	1
Old zinc	10	47	--	49	49	8
Engravers' plates	--	--	--	--	--	--
Skimming and ashes	2,586	15,884	9,888	--	9,888	8,582
Sal skimmings	5,331	7,239	8,396	--	8,396	4,174
Die-cast skimmings	--	44	44	--	44	--
Galvanizers' dross	--	--	--	--	--	--
Diecastings	21	104	--	115	115	10
Rod and die scrap	3	91	--	79	79	15
Flue dust	321	4,787	4,768	--	4,768	340
Chemical residues	963	26,111	24,036	--	24,036	3,038
Total	9,237	54,310	47,136	243	47,379	16,168
All classes of consumers:						
New clippings	49	722	677	--	677	94
Old zinc	516	6,074	--	6,158	6,158	432
Engravers' plates	145	1,145	--	1,104	1,104	186
Skimmings and ashes	8,651	80,122	71,597	--	71,597	17,176
Sal skimmings	5,654	7,443	8,807	--	8,807	4,290
Die-cast skimmings	2,207	8,065	7,070	--	7,070	3,202
Galvanizers' dross	12,896	54,059	53,087	--	53,087	13,868
Diecastings	3,498	48,826	--	46,722	46,722	5,602
Rod and die scrap	34	3,180	--	3,141	3,141	73
Flue dust	1,258	9,805	10,196	--	10,196	867
Chemical residues	963	36,181	34,105	--	34,105	3,039
Total	35,871	255,622	185,539	57,125	242,664	48,829

[1] Figures partly revised.

Table 13.—Production of zinc products from zinc-base scrap in the United States

(Short tons)

Products	1970	1971	1972	1973	1974
Redistilled slab zinc	77,156	80,923	73,718	r 83,187	78,535
Zinc dust	29,605	29,095	40,569	36,531	29,339
Remelt zinc	3,494	1,590	5,850	1,096	893
Remelt die-cast slab	16,686	18,339	13,555	12,595	12,358
Zinc-die and diecasting alloys	4,361	3,316	3,927	4,786	4,393
Galvanizing stocks	762	633	872	670	872
Secondary zinc in chemical products	42,238	45,312	50,047	56,591	56,275

r Revised.

Table 14.—Zinc recovered from scrap processed in the United States, by kind of scrap and form of recovery

(Short tons, zinc content)

Kind of scrap	1973	1974	Form of recovery	1973	1974
New Scrap:			As metal:		
Zinc-base	137,671	122,232	By distillation:		
Copper-base	152,190	136,791	Slab zinc[1]	[r] 83,187	78,535
Aluminum-base	4,035	3,750	Zinc dust	36,202	29,075
Magnesium-base	306	300	By remelting	1,737	1,743
Total	294,202	263,073	Total	[r] 121,126	109,353
Old scrap:			In zinc-base alloys	16,362	15,779
Zinc-base	[r] 46,022	45,722	In brass and bronze	180,674	148,751
Copper-base	38,494	25,733	In aluminum-base alloys	7,961	7,879
Aluminum-base	4,436	3,854	In magnesium-base alloys	546	445
Magnesium-base	106	100	In chemical products:		
			Zinc oxide (lead free)	29,289	32,104
Total	[r] 89,058	75,409	Zinc sulfate	9,444	9,838
Grand total	[r] 383,260	338,482	Zinc chloride	16,639	11,035
			Miscellaneous	1,219	3,298
			Total	262,134	229,129
			Grand total	[r] 383,260	338,482

[r] Revised.

[1] Includes zinc content of redistilled slab made from remelt die-cast slab.

Table 15.—Zinc dust produced in the United States

Year	Quantity (short tons)	Value	
		Total (thousands)	Average per pound
1970	51,136	$20,045	$0.196
1971	50,259	19,691	.196
1972	59,358	24,669	.208
1973	56,154	29,279	.261
1974	50,775	46,398	.457

Table 16.—Consumption of zinc in the United States

(Short tons)

	1970	1971	1972	1973	1974
Slab zinc	1,186,951	1,254,059	1,418,349	1,503,938	1,287,696
Ores (recoverable zinc content)[1]	124,781	119,254	118,305	129,651	127,113
Secondary (recoverable zinc content)[2]	259,864	277,381	307,369	298,336	258,204
Total	1,571,596	1,650,694	1,844,023	1,931,925	1,673,013

[1] Includes ore used directly in galvanizing.

[2] Excludes redistilled slab and remelt zinc.

Table 17.—Slab zinc consumption in the United States, by industry use
(Short tons)

Industry and product	1970	1971	1972	1973	1974
Galvanizing:					
Sheet and strip	253,155	255,335	294,205	321,927	291,008
Wire and wire rope	30,857	29,895	30,769	34,315	27,579
Tubes and pipe	64,479	65,122	64,549	68,048	59,995
Fittings (for tube and pipe)	9,498	10,240	11,106	11,969	9,294
Tanks and containers	3,924	2,759	3,645	2,941	3,203
Structural shapes	18,761	18,589	20,302	21,714	36,784
Fasteners	5,318	5,159	4,310	4,782	5,703
Pole-line hardware	9,938	8,358	8,437	8,193	6,783
Fencing, wire, cloth, and netting	18,114	20,232	21,995	25,418	26,284
Other and unspecified uses	60,205	59,063	58,886	64,530	56,636
Total	474,249	474,752	518,204	563,837	523,269
Brass products:					
Sheet, strip, and plate	61,672	78,929	105,405	109,582	99,971
Rod and wire	41,459	46,514	63,143	63,164	57,725
Tubes	9,086	9,399	8,886	10,858	9,930
Castings and billets	4,606	4,479	6,840	6,000	4,431
Copper-base ingots	9,946	10,440	7,137	6,895	8,244
Other copper-base products	978	725	736	1,151	1,262
Total	127,747	150,486	192,147	197,650	181,563
Zinc-base alloy:					
Diecasting alloy	453,490	504,823	566,932	598,725	436,377
Dies and rod alloy	87	270	56	111	384
Slush and sand-casting alloy	10,059	11,018	12,773	11,770	3,498
Total	463,636	516,111	579,761	610,606	440,259
Rolled zinc	41,065	38,852	45,216	40,763	39,393
Zinc oxide	43,829	40,043	51,992	61,734	65,376
Other uses:					
Light-metal alloys	3,985	4,575	6,300	7,466	9,690
Other[1]	32,440	29,240	24,729	21,882	28,146
Total	36,425	33,815	31,029	29,348	37,836
Grand total	1,186,951	1,254,059	1,418,349	1,503,938	1,287,696

[1] Includes zinc used in making zinc dust, wet batteries, desilverizing lead, bronze powder, alloys, chemicals, castings, and miscellaneous uses not elsewhere mentioned.

Table 18.—Slab zinc consumption in the United States in 1974, by grade and industry use
(Short tons)

Industry	Special High Grade	High Grade	Inter-mediate	Brass Special	Prime[1] Western	Remelt	Total
Galvanizing	31,794	33,438	9,672	112,874	334,832	659	523,269
Brass and bronze	41,270	101,031	66	7,593	31,516	87	181,563
Zinc-base alloys	433,850	4,757	13	346	986	307	440,259
Rolled zinc	18,997	2,869	16,552	594	381	--	39,393
Zinc oxide	28,420	5,131	2	566	31,124	133	65,376
Other	18,520	5,898	40	131	13,218	29	37,836
Total	572,851	153,124	26,345	122,104	412,057	1,215	1,287,696

[1] Includes select grade.

Table 19.—Rolled zinc produced and quantity available for consumption in the United States

	1973			1974		
		Value			Value	
	Short tons	Total (thousands)	Average per pound	Short tons	Total (thousands)	Average per pound
Production:[1]						
Photoengraving plate	8,379	$6,401	$0.382	6,367	$8,859	$0.696
Sheet zinc less than 0.375 inch thick	--	--	--	--	--	--
Strip and foil	30,362	19,869	.327	30,111	27,669	.459
Total rolled zinc[2]	41,301	28,524	.345	38,417	38,640	.503
Exports	2,480	2,100	.423	3,487	3,842	.551
Imports	236	159	.339	640	568	.445
Available for consumption	37,801	--	--	36,536	--	--

[1] Figures represent net production. In addition, 28,901 tons in 1973 and 33,474 tons in 1974 were rerolled from scrap originating in fabricating plants operating in connection with zinc mills.

[2] Includes other plate over 0.375 inch thick, and rod and wire. Bureau of Mines not at liberty to publish separately.

Table 20.—Slab zinc consumption in the United States in 1974, by industry and State

(Short tons)

	Galvanizers	Brass mills[1]	Die casters[2]	Other[3]	Total
Alabama	40,924	W	--	W	43,098
Arizona	W	--	--	W	W
Arkansas	W	--	--	W	W
California	33,300	W	W	2,782	49,240
Colorado	W	W	W	W	3,558
Connecticut	3,058	33,182	W	W	40,498
Delaware	W	W	W	W	W
Florida	5,042	--	--	--	5,042
Georgia	W	--	W	--	W
Hawaii	W	--	--	--	W
Idaho	--	--	W	W	W
Illinois	61,016	29,864	68,096	13,284	172,260
Indiana	56,663	W	37,601	W	137,178
Iowa	643	--	W	W	1,840
Kansas	W	W	W	--	W
Kentucky	W	W	--	W	16,319
Louisiana	4,073	--	W	W	4,936
Maine	W	--	--	--	W
Maryland	W	--	--	W	24,144
Massachusetts	3,907	W	W	W	7,028
Michigan	13,085	16,559	99,304	1,439	130,387
Minnesota	979	--	--	--	979
Mississippi	1,460	--	--	--	1,460
Missouri	8,338	W	W	W	12,499
Nebraska	4,993	W	--	W	5,818
New Jersey	2,555	5,870	W	W	16,468
New York	12,485	W	64,426	W	101,299
North Carolina	W	--	W	W	W
Ohio	91,084	W	74,779	W	176,819
Oklahoma	5,789	--	W	W	7,902
Oregon	1,176	W	W	--	1,656
Pennsylvania	67,529	10,337	W	W	166,359
Rhode Island	W	--	--	W	W
South Carolina	W	--	--	--	W
Tennessee	W	--	W	W	28,212
Texas	16,975	W	W	2,730	52,444
Utah	W	W	--	--	W
Virginia	W	W	W	W	781
Washington	849	--	--	2,289	3,138
West Virginia	W	W	--	W	29,134
Wisconsin	1,518	W	8,539	W	14,648
Undistributed	85,169	85,664	87,207	119,919	81,342
Total[4]	522,610	181,476	439,952	142,448	1,286,481

W Withheld to avoid disclosing individual company confidential data; included with "Undistributed."

[1] Includes brass mills, brass ingot makers, and brass foundries.

[2] Includes producers of zinc-base alloy for diecastings, stamping dies, and rods.

[3] Includes slab zinc used in rolled zinc products and in zinc oxide.

[4] Excludes remelt zinc.

Table 21.—Production and shipments of zinc pigments and compounds[1] in the United States

Pigment or compound	1973				1974			
	Production (short tons)	Shipments			Production (short tons)	Shipments		
		Quantity (short tons)	Value[2]			Quantity (short tons)	Value[2]	
			Total (thousands)	Average per ton			Total (thousands)	Average per ton
Zinc oxide[3]	252,475	252,833	$88,378	$350	256,355	232,542	$144,078	$620
Zinc sulfate	43,866	45,197	5,510	122	46,135	44,135	9,048	205

[1] Excludes leaded zinc oxide, lithopone, and zinc chloride; figures withheld to avoid disclosing individual company confidential data.

[2] Value at plant, exclusive of container.

[3] Zinc oxide containing 5% or more lead is classed as leaded zinc oxide.

Table 22.—Zinc content of zinc pigments[1] and compounds produced by domestic manufacturers, by source

(Short tons)

Pigment or compound	1973				1974			
	Zinc in pigments and compounds produced from—			Total zinc in pigments and compounds	Zinc in pigments and compounds produced from—			Total zinc in pigments and compounds
	Ore	Slab zinc	Secondary material		Ore	Slab zinc	Secondary material	
Zinc oxide	112,638	67,457	31,821	211,916	110,664	65,271	28,571	204,506
Zinc sulfate	6,339	--	8,226	14,565	4,306	--	9,570	13,876

[1] Excludes leaaed zinc oxide, zinc sulfide, and lithopone; figures withheld to avoid disclosing individual company confidential data.

Table 23.—Distribution of zinc oxide shipments, by industry[1]

(Short tons)

Industry	1970	1971	1972	1973	1974
Rubber	111,421	124,472	129,170	129,462	108,976
Paints	21,894	24,990	27,244	26,115	17,029
Ceramics	9,011	8,125	10,702	11,678	12,177
Chemicals	19,435	18,901	22,781	26,187	35,167
Agriculture	2,246	1,615	1,101	2,044	6,066
Photocopying	31,850	34,504	36,190	38,724	34,577
Other	17,426	14,896	18,679	18,623	18,550
Total	213,283	227,508	245,867	252,833	232,542

[1] For information on leaded zinc oxide shipments prior to 1971, refer to the 1970 Minerals Yearbook.

Table 24.—Distribution of zinc sulfate shipments, by industry

(Short tons)

Year	Agriculture		Other [1]		Total	
	Gross weight	Dry basis	Gross weight	Dry basis	Gross weight	Dry basis
1970	17,213	14,803	36,856	26,572	54,069	41,375
1971	16,268	13,812	33,035	28,690	49,303	42,502
1972	10,496	8,602	29,099	25,935	39,595	34,537
1973	13,909	8,353	31,288	24,902	45,197	33,255
1974	14,508	8,677	29,627	18,245	44,135	26,922

[1] Includes rayon; Bureau of Mines not at liberty to publish separately.

Table 25.—Stocks of slab zinc at zinc-reduction plants in the United States, December 31

(Short tons)

Stocks	1970	1971	1972	1973 r	1974
At primary reduction plants	r 123,456	r 48,099	r 28,843	25,229	38,293
At secondary distilling plants	738	475	1,225	718	1,427
Total	r 124,194	r 48,574	r 30,068	25,947	39,720

r Revised.

Table 26.—Consumers stocks of slab zinc at plants, December 31, by grade

(Short tons)

Date	Special High Grade	High Grade	Intermediate	Brass Special	Prime Western	Remelt	Total
Dec. 31, 1973	47,775	9,703	2,296	14,314	39,260	969	114,317
Dec. 31, 1974	61,379	14,784	4,205	32,395	97,891	95	210,749

Table 27.—Average monthly U.S., LME,[1] and European Producers' prices for Prime Western Zinc and equivalent

(Metallic zinc, cents per pound)

Month	1973			1974		
	United States	LME cash	European producer	United States	LME cash	European producer
January	18.66	17.53	18.49	31.17	60.18	30.26
February	19.28	19.12	19.05	31.90	68.57	30.96
March	19.85	21.50	21.31	32.64	73.76	33.37
April	20.32	23.25	21.41	34.82	78.90	35.77
May	20.39	24.88	21.81	34.78	80.61	36.13
June	20.31	29.71	23.45	34.95	63.79	35.78
July	20.34	33.09	24.58	36.40	49.65	35.77
August	20.34	41.43	24.71	37.62	48.27	35.11
September	20.31	44.20	25.00	39.26	41.26	36.41
October	20.37	52.65	27.55	39.33	38.42	38.10
November	20.35	73.31	28.42	39.23	35.96	37.97
December	27.37	73.29	31.54	39.24	34.95	38.04
Average for year	20.66	38.55	24.00	35.95	56.13	35.29

[1] London Metal Exchange.

Source: Metals Week.

Table 28.—U.S. exports of zinc, by country

Destination	1972		1973		1974	
	Quantity (short tons)	Value (thousands)	Quantity (short tons)	Value (thousands)	Quantity (short tons)	Value (thousands)
Unwrought zinc and zinc alloys:						
Belgium-Luxembourg	--	--	1,964	$1,209	4,370	$3,578
Brazil	56	$57	3,050	2,376	9,094	9,474
Cambodia	--	--	--	--	72	72
Canada	719	219	1,565	804	1,333	948
Chile	17	10	462	610	988	1,511
Colombia	5	3	1,891	992	1,385	1,083
Costa Rica	--	--	673	317	678	735
Dominican Republic	--	--	106	43	293	207
El Salvador	1	1	531	281	456	347
France	--	--	--	--	810	278
Germany, West	--	--	1	7	104	81
Greece	--	--	--	--	373	515
Guatemala	1	1	518	281	674	831
Indonesia	1	1	300	229	1	3
Israel	--	--	1	1	226	331
Italy	403	289	707	394	534	978
Japan	3	1	4,679	3,661	2,385	2,498
Korea, Republic of	--	--	615	355	1,301	1,385
Malaysia	--	--	108	75	11	16
Mexico	5	4	99	76	144	158
Netherlands	2	1	1,498	621	3,399	2,547
Nicaragua	3	2	112	43	226	249
Pakistan	1,037	634	47	51	107	70
Panama	5	3	299	145	282	300
Philippines	5	3	1,407	922	1,925	1,926
Singapore	1	1	113	81	491	530
Spain	11	7	50	31	60	34
Switzerland	--	--	964	328	12	5
Taiwan	42	23	17	14	185	173
Thailand	--	--	65	51	227	247
United Kingdom	3,788	569	841	861	1,965	1,381
Venezuela	262	119	2,151	1,411	2,947	3,256
Vietnam, South	--	--	110	23	441	399
Other	140	81	196	182	428	464
Total	6,507	1,979	25,140	16,475	37,927	36,610
Wrought zinc and zinc alloys:						
Algeria	--	--	22	23	3	5
Argentina	32	23	28	21	19	26
Australia	58	51	27	29	70	113
Belgium-Luxembourg	43	55	648	350	5,143	3,220
Brazil	9	12	101	41	299	140
Canada	4,694	2,607	4,043	2,239	3,659	2,797
Chile	23	16	27	22	56	67
Colombia	7	5	33	31	58	79
Costa Rica	12	12	11	11	10	18
Dominican Republic	23	14	21	17	15	22
Ecuador	8	8	27	29	45	62
Egypt	9	8	36	25	9	10
El Salvador	10	10	72	53	11	29
France	33	39	56	62	59	77
Germany, West	26	48	302	135	30	193
Hong Kong	6	5	49	38	204	212
Indonesia	--	--	--	--	150	224
Israel	84	60	82	64	55	65
Jamaica	26	23	10	16	27	47
Japan	28	29	60	57	44	47
Lebanon	41	31	34	27	34	30
Mexico	169	120	184	249	277	209
Netherlands	3	6	3	6	572	723
New Zealand	15	10	62	43	85	91
Peru	2	7	21	25	16	23
Philippines	102	51	172	114	351	169
Singapore	1	1	9	10	40	51
South Africa, Republic of	173	150	139	137	271	369
Spain	--	--	70	59	201	257
Sweden	--	--	39	24	4	4
Syrian Arab Republics	--	--	9	7	40	39
Taiwan	4	3	86	67	61	82
Thailand	22	13	66	38	33	24
United Arab Emirates	1	2	10	12	167	337
United Kingdom	157	171	162	78	340	275
Venezuela	139	124	140	134	272	407
Other	328	235	122	156	348	543
Total	6,288	3,949	6,983	4,449	13,078	11,086

Table 29.—U.S. exports of zinc, by class

Year	Blocks, pigs, anodes, etc				Wrought zinc and zinc alloys			
	Unwrought		Unwrought alloys		Sheet, plates, and strip		Angles, bars, pipes, rods, etc.	
	Quantity (short tons)	Value (thousands)	Quantity (short tons)	Value (thousands)	Quantity (short tons)	Value (thousands)	Quantity (short tons)	Value (thousands)
1972	4,324	$714	2,183	$1,265	2,419	$2,138	3,869	$1,811
1973	14,566	8,259	10,574	8,216	2,480	2,100	4,503	2,349
1974	19,062	16,511	18,865	20,009	3,487	3,842	9,591	7,244

Year	Waste and scrap		Dust (blue powder)	
	Quantity (short tons)	Value (thousands)	Quantity (short tons)	Value (thousands)
1972	1,105	$297	341	$134
1973	6,366	2,307	666	410
1974	10,936	5,461	1,152	819

Table 30.—U.S. exports of zinc pigments

Kind	1973		1974	
	Quantity (short tons)	Value (thousands)	Quantity (short tons)	Value (thousands)
Zinc oxide	^{r}7,076	^{r}$2,083	12,245	$6,438
Lithopone	986	357	1,185	967
Total	^{r}8,062	^{r}2,440	13,430	7,405

^{r} Revised.

Table 31.—U.S. imports for consumption of zinc, by country

Country	1972		1973		1974	
	Quantity (short tons)	Value (thousands)	Quantity (short tons)	Value (thousands)	Quantity (short tons)	Value (thousands)
ORES AND CONCENTRATES (zinc content) [1]						
Argentina	--	--	3	([2])	6	$1
Australia	926	$186	1,248	$181	4,134	522
Bolivia	77	21	5	1	1	([2])
Brazil	--	--	97	15	--	--
Canada	109,720	15,874	88,433	15,199	73,635	18,678
Germany, West	1,162	260	848	147	--	--
Guatemala	--	--	673	101	--	--
Honduras	3,680	547	15,987	2,325	18,033	3,793
Ireland	2,175	368	2,021	402	883	152
Japan	--	--	--	--	5	1
Mexico	39,282	4,530	^{r}30,985	^{r}4,344	26,647	6,480
Nicaragaua	--	--	1,330	155	1,489	236
Peru	8,000	1,304	^{r}12,544	^{r}1,838	8,900	1,567
South Africa, Republic of	9,041	1,185	--	--	--	--
Total	174,063	24,275	^{r}154,174	^{r}24,708	133,733	31,430
BLOCKS, PIGS, OR SLABS						
Angola	--	--	--	--	1,922	1,289
Australia	41,079	14,863	41,415	18,892	38,909	29,903
Belgium-Luxembourg	39,616	13,998	^{r}39,682	^{r}20,963	30,379	31,253
Bulgaria	--	--	221	199	--	--
Canada	272,493	92,255	^{r}344,819	^{r}148,302	278,075	184,095
Ecuador	909	301	121	46	--	--
Finland	5,102	1,416	14,183	5,581	10,590	6,998
France	11,825	4,225	10,671	5,667	4,477	5,271
Germany, West	31,358	11,551	8,203	4,562	8,177	7,890
Hong Kong	--	--	--	--	110	109
Italy	--	--	--	--	7,685	9,404
Japan	30,072	10,968	42,668	19,039	50,827	55,919
Liberia	--	--	--	--	2,731	2,008
Mexico	8,394	2,276	1,913	732	25,675	21,982
Mozambique	--	--	--	--	558	364
Netherlands	14,001	5,096	3,036	1,997	4,895	5,279
Norway	--	--	220	300	149	112
Peru	30,625	9,760	19,343	7,171	31,101	24,807
Poland	4,418	1,584	^{r}14,498	^{r}9,332	8,922	9,968
Singapore	--	--	--	--	229	204
South Africa, Republic of	--	--	329	264	774	615
Spain	1,102	381	11	10	2,413	2,540
Taiwan	--	--	221	112	--	--
U.S.S.R	--	--	3,599	2,777	221	261
United Kingdom	1,553	563	^{r}8,808	^{r}5,757	5,447	4,938
Yugoslavia	1,543	589	^{r}8,997	^{r}9,245	11,752	14,269
Zaire	22,493	6,860	28,440	12,488	17,838	11,772
Zambia	--	--	273	140	--	--
Other	60	21	130	47	--	--
Total	516,643	176,707	^{r}590,751	^{r}273,628	543,806	431,250

^{r} Revised.

[1] Does not include zinc ores and concentrates for refining and export: 1972: Canada 4,787 short tons ($735,225); Mexico 171 short tons ($27,437); Ireland 176 short tons ($17,439); the Netherlands 98 short tons ($17,595); Belgium-Luxembourg 16 short tons ($2,690). 1973: Canada 3,979 short tons ($790,625); Mexico 11,816 short tons ($1,832,675); Honduras 875 short tons ($126,607); Nicaragua 5,431 short tons ($363,030); Peru 1,287 short tons ($516,447); Ireland 156 short tons ($15,467). 1974: none.

[2] Less than ½ unit.

Table 32.—U.S. general imports of zinc, by country

Country	1972		1973		1974	
	Quantity (short tons)	Value (thousands)	Quantity (short tons)	Value (thousands)	Quantity (short tons)	Value (thousands)
ORES AND CONCENTRATES (zinc content)						
Australia	5,871	$239	7,282	$288	5,606	$652
Canada	135,534	19,483	124,261	22,057	162,482	51,104
Germany, West	1,162	260	848	147	--	--
Guatemala	723	130	--	--	--	--
Honduras	17,370	2,415	6,029	539	6,232	3,184
Ireland	5,978	885	2,001	401	1,075	160
Japan	--	--	519	93	--	--
Mexico	57,315	7,106	[r] 34,459	[r] 5,116	24,188	7,509
Nicaragua	10,960	1,163	11,244	1,324	10,639	4,176
Peru	15,256	2,007	12,981	1,812	13,860	4,341
South Africa, Republic of	4,690	779	--	--	--	--
Thailand	--	--	--	--	13,317	1,992
Turkey	--	--	--	--	2,647	911
Other	9	(1)	10	(1)	2	2
Total	254,868	34,467	[r] 199,634	[r] 31,777	240,043	74,031
BLOCKS, PIGS, OR SLABS						
Angola	--	--	--	--	1,922	1,289
Australia	39,623	14,441	42,076	19,256	38,909	29,903
Belgium-Luxembourg	39,616	13,998	[r] 40,128	[r] 21,359	30,379	31,253
Bulgaria	--	-	221	199	--	--
Canada	271,130	91,826	344,819	148,302	270,156	182,714
Ecuador	909	301	121	46	--	--
Finland	8,583	2,572	14,183	5,581	10,590	6,998
France	11,825	4,225	10,727	5,705	4,477	5,271
Germany, West	31,358	11,551	8,203	4,562	8,289	8,008
Hong Kong	--	--	--	--	110	109
Italy	--	--	--	--	7,911	9,683
Japan	30,072	10,968	42,668	19,039	52,674	57,651
Liberia	--	--	--	--	2,731	2,008
Mexico	8,394	2,276	1,913	782	23,515	21,750
Mozambique	--	--	--	--	558	364
Netherlands	14,001	5,096	3,229	2,095	5,228	5,708
Norway	--	--	220	300	149	112
Peru	30,625	9,760	19,343	7,171	31,101	24,807
Poland	4,199	1,514	[r] 13,388	[r] 9,279	9,253	10,311
Romania	5,526	1,603	--	--	--	--
Singapore	--	--	--	--	229	209
South Africa, Republic of	--	--	329	264	774	615
Spain	1,102	381	11	10	5,059	4,832
U.S.S.R	--	-	3,599	2,777	221	261
United Kingdom	1,553	563	[r] 9,028	[r] 5,868	5,117	4,677
Yugoslavia	1,543	589	[r] 8,997	[r] 9,245	12,348	14,770
Zaire	22,493	6,860	28,440	12,488	17,838	11,772
Zambia	--	--	273	140	--	--
Other	60	21	130	47	--	--
Total	522,612	178,545	[r] 592,046	[r] 274,465	539,538	435,070

[r] Revised.

[1] Less than ½ unit.

Table 33.—U.S. imports for consumption of zinc, by class

	Ore (zinc content)		Blocks, pigs, slabs [1]		Sheets, plates, strips other forms		Waste and scrap	
	Quantity (short tons)	Value (thousands)	Quantity (short tons)	Value (thousands)	Quantity (short tons)	Value (thousands)	Quantity (short tons)	Value (thousands)
1972	174,063	$24,275	516,643	$176,707	485	$310	814	$235
1973	r 154,174	r 24,708	r 590,751	r 278,623	236	159	1,537	683
1974	133,733	31,430	543,806	431,250	640	568	2,418	1,241

	Dross and skimmings (zinc content)		Zinc fume (zinc content)		Dust, powder, and flakes		Total value [2] (thousands)
	Quantity (short tons)	Value (thousands)	Quantity (short tons)	Value (thousands)	Quantity (short tons)	Value (thousands)	
1972	1,936	$358	3,139	$481	r 9,199	r $3,825	$206,191
1973	2,328	506	r 17,953	r 2,810	4,873	2,468	r 304,857
1974	3,863	1,786	18,235	3,283	9,131	9,799	479,357

r Revised.

[1] Unwrought alloys of zinc were imported as follows: 1972, 187 short tons ($77,504); 1973, 1,346 short tons ($709,322); 1974, 11,491 short tons ($11,397,967).

[2] In addition, manufactures of zinc were imported as follows: 1972, $265,089; 1973, $607,998; 1974, $562,521.

Table 34.—U.S. imports for consumption of zinc pigments and compounds

Kind	1973		1974	
	Quantity (short tons)	Value (thousands)	Quantity (short tons)	Value (thousands)
Zinc oxide	r 27,811	r $11,535	26,088	$19,427
Zinc sulfide	854	428	789	473
Lithopone	84	29	262	139
Zinc chloride	2,054	536	2,227	1,264
Zinc sulfate	4,410	699	7,906	2,439
Zinc cyanide	102	52	116	149
Zinc hydrosulfite	20	7	74	59
Zinc compounds, n.s.p.f	1,467	785	1,974	2,098
Total	r 36,802	r 14,071	39,436	26,048

r Revised.

Table 35.—Zinc: World mine production (content of ore) by country

(Short tons)

Country[1]	1972	1973	1974[p]
North America:			
Canada[2]	[r] 1,244,142	1,352,074	1,278,139
Guatemala (exports)	[r] 929	309	--
Honduras	25,678	21,681	26,411
Mexico	299,656	299,137	289,594
Nicaragua	19,285	12,228	16,334
United States	478,318	478,850	499,873
South America:			
Argentina	[r] 49,083	44,749	41,010
Bolivia[3]	46,372	57,038	58,145
Brazil	[r] 49,162	[r] [e] 55,000	[e] 55,000
Chile	1,281	1,766	3,692
Colombia	[e] 90	161	41
Ecuador	54	--	223
Peru	[r] 414,611	457,072	437,838
Europe:			
Austria	22,575	24,417	23,123
Bulgaria	88,000	88,000	[e] 90,000
Czechoslovakia	[r] 10,207	11,000	13,200
Finland	54,998	64,587	64,857
France	14,650	14,705	15,720
Germany, East[e]	8,800	6,600	5,500
Germany, West	134,188	135,411	127,916
Greece	[r] 19,623	20,765	22,000
Greenland	--	29,983	97,554
Hungary[e]	5,300	5,300	3,300
Ireland	[r] 104,630	75,828	73,080
Italy	[r] 113,100	86,640	83,952
Norway	[r] 16,108	21,839	24,144
Poland	[r] 245,150	231,500	238,100
Portugal	1,971	703	--
Romania (recoverable)[e]	44,000	46,000	47,000
Spain	[r] 98,583	104,118	103,324
Sweden	125,364	130,670	120,042
U.S.S.R.[e]	717,000	740,000	750,000
United Kingdom	1,357	3,207	[e] 3,900
Yugoslavia	106,628	107,396	[e] 186,300
Africa:			
Algeria	[r] 18,783	15,870	29,100
Congo, Republic of	2,373	2,980	2,650
Morocco	21,500	19,312	15,210
South Africa, Republic of	2,215	18,757	37,513
South-West Africa, Territory of[4]	38,296	41,798	[5] 45,932
Tunisia	[r] 11,240	8,763	6,268
Zaire	[r] 110,496	97,000	99,000
Zambia	[r] 77,710	80,690	90,500
Asia:			
Burma	[r] 4,546	4,202	4,731
China, People's Republic of[e]	110,000	110,000	110,000
India	9,776	13,682	16,657
Iran[6]	57,596	78,820	90,940
Japan	[r] 167,529	290,964	265,513
Korea, North[e]	[r] 165,000	[r] 176,000	178,000
Korea, Republic of	[r] 41,136	53,263	46,590
Philippines	5,074	5,921	8,567
Thailand[7]	--	66	16,500
Turkey	27,155	24,486	26,500
Oceania:			
Australia	[r] 558,932	524,102	499,901
New Zealand	1,821	1,423	--
Total	[r] 5,992,071	6,296,833	6,384,384

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[e] Estimate. [p] Preliminary. [r] Revised.

[1] In addition to the countries listed, North Vietnam also produces zinc, but information is inadequate to make reliable estimates of output levels.

[2] Zinc content of concentrates.

[3] Sum of production by COMIBOL and exports by medium and small mines.

[4] Data are compiled from operating company reports of Tsumeb Corp. Ltd. South-West Africa Co. Ltd. and South African Iron and Steel Industrial Corp., Ltd. (ISCOR) for Imcor Zinc (Pty.) Ltd.'s Rosh Pinah mine. Data from Tsumeb Corp. Ltd. are for calendar years; data from other companies are for fiscal years ending June 30 of the year stated.

[5] Figure comprises reported production of Tsumeb Corp., Ltd. and South-West Africa Co., Ltd. plus an estimate for Rosh Pinah mine.

[6] Year beginning March 21 of that stated.

[7] Contained in zinc concentrates. Additional quantities of zinc may be contained as a byproduct in lead concentrates produced, but information is inadequate to make reliable estimates of such production, if any.

Table 36.—World smelter production of zinc, by country

(Short tons)

Country[1]	1972	1973	1974[p]
North America:			
Canada	524,885	587,038	469,884
Mexico	[r] 92,360	78,730	147,013
United States	633,180	583,479	555,188
South America:			
Argentina	[r] 44,974	39,350	41,010
Brazil	17,149	24,580	33,641
Peru	74,032	73,959	76,012
Europe:			
Austria[2]	18,604	18,738	18,133
Belgium[2]	[r] 286,274	309,846	323,602
Bulgaria[2]	[r] 88,000	88,000	93,000
Finland	89,393	88,915	101,177
France	288,271	285,915	304,806
Germany, East[e] [2]	17,000	20,000	20,000
Germany, West	[r] 235,450	265,880	275,140
Italy	171,807	200,633	216,537
Netherlands	[r] 55,450	33,620	86,200
Norway	[r] 80,852	88,741	79,277
Poland[2]	251,300	259,000	256,800
Romania[e]	44,000	46,000	47,000
Spain	109,854	118,024	142,692
U.S.S.R.[e]	717,000	740,000	750,000
United Kingdom	81,379	92,440	93,030
Yugoslavia[2]	53,617	69,579	95,218
Africa:			
South Africa, Republic of	[r] 52,360	64,040	75,000
Zaire	78,139	74,678	70,500
Zambia	61,711	58,814	64,329
Asia:			
China, People's Republic of[e]	110,000	110,000	110,000
India	27,808	14,010	23,262
Japan	887,114	929,224	936,850
Korea, North[e]	132,000	143,000	145,000
Korea, Republic of	11,576	13,878	12,729
Oceania: Australia	[r] 325,215	327,578	305,154
Total	[r] 5,655,754	5,847,689	5,968,184

[e] Estimate. [p] Preliminary. [r] Revised.

[1] In addition to the countries listed, North Vietnam also produces zinc, but available information is inadequate to make reliable estimates of output levels.

[2] Includes production from reclaimed scrap.

Zirconium and Hafnium

By Sarkis G. Ampian [1]

Zircon production and sales by domestic mining companies increased 8% in tonnage and 50% in value in 1974 above that in 1973. Zircon exports decreased 26% from 28,921 tons in 1973 to 21,487 tons in 1974 while imports decreased 36% from 98,023 short tons in 1973 to 62,504 short tons in 1974. Exports of zirconium metal and zirconium alloys generally increased in 1974 while zirconium oxide declined. Production of zirconium-bearing compounds for chemicals and refractories also increased. Zircon consumption by foundries decreased from 92,500 short tons in 1973 to 80,000 tons in 1974. Some hafnium was also produced.

The 1974 worldwide zircon supply-demand picture was characterized by an initial strong demand, increasing supply and prices, and a weakening in demand at yearend. Domestically, zircon reflected the worldwide situation and was in tight supply during most of the year because of increased demand, largely in manufacturing specialized refractories and abrasives, which resulted in an inventory problem when shipments abruptly declined in the last quarter. Increased domestic production was more than sufficient to offset the decreased supply brought about by the nearly 40% decline in zircon imports.

Recycling of spent foundry zircon and substitution of chromite and aluminum silicate-minerals for some zircon foundry applications were also commonplace. AMAX Speciality Metals Corp., one of the two zirconium and hafnium sponge producers, and Stauffer Chemical Co., one of the two metallurgical-grade zirconium tetrachloride producers, ceased production in September 1974.

Zircon use was largely in foundry sands, refractories, abrasives, ceramics, and as a source of zirconium metal. The metal was used mostly in nuclear reactors, in corrosion-resistant equipment for industrial plants, and in refractory alloys. Hafnium was used in nuclear reactors, in flashbulbs, and in refractory alloys.

Legislation and Government Programs.—The Statistical Supplement to the Stockpile Report to Congress, December 31, 1974, showed no objectives for zirconium and hafnium materials. Excess stocks of 15,998 tons of Brazilian baddeleyite and 1 ton of zirconium metal powder were sold. The U.S. Atomic Energy Commission (AEC) had an inventory as of June 30, 1974, of approximately one-half ton of zirconium crystal bar and scrap, 937 tons of zirconium sponge, 163 tons of Zircaloy ingot and shapes, one-half ton of hafnium scrap, 5 tons of hafnium oxide, one-half ton of hafnium sponge and shapes, and 39 tons of hafnium crystal bar.

A Food and Drug Administration (FDA) advisory panel submitted a recommendation to FDA challenging the safety of products containing zirconium compounds. The panel suggested that these compounds may break down to form other compounds that could cause lung damage to users. Industry spokesman called the panel's recommendations and suggestions as "hypothetical and speculative" and intimated that conclusive evidence, based on extensive animal inhalation studies on these products, would be presented at an impending meeting and fully exonerate their products from any lung-related problems.[2]

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[1] Physical scientist, Division of Nonmetallic Minerals.

[2] Chemical Week. Spray Safety Challenged. V. 115, No. 24, Dec. 11, 1974, p. 16.

Table 1.—Salient zirconium statistics in the United States

(Short tons)

Product	1970	1971	1972	1973	1974
Zircon:					
Production	W	W	W	W	W
Exports	4,836	9,429	17,360	28,921	21,487
Imports	94,759	96,387	67,537	98,023	62,504
Consumption •	[1]145,000	[1]166,000	[1]168,000	[1]175,000	[1]167,000
Stocks, yearend, dealers and consumers [2]	52,000	42,500	44,500	51,500	41,900
Zirconium oxide:					
Production [3]	4,957	10,770	12,020	14,300	11,630
Producers' stocks, yearend [3]	1,050	680	942	648	1,480

• Estimate. W Withheld to avoid disclosing individual company confidential data.

[1] Includes baddeleyite: 1970—355 tons; 1971—871 tons; 1972—385 tons; 1973—1,019 tons; 1974—• 2,950 tons.

[2] Excludes foundries.

[3] Excludes oxide produced by zirconium metal producers.

DOMESTIC PRODUCTION

E. I. du Pont de Nemours & Co. and Titanium Enterprises, Inc., were the only major producers of zircon mineral concentrate in the United States. Zircon was recovered from mineral sands at the dredging and milling facilities owned by du Pont at Starke, Fla.; by Humphreys Mining Co. for du Pont, near Folkston, Ga.; and by Titanium Enterprises at Green Cove Springs, Fla. Production data were withheld from publication to avoid disclosing individual company confidential data. The combined zircon capacity of these three plants is estimated to be 135,000 tons per year.

Humphreys Mining Co. ceased mining and wet mill operations at Folkston about midyear and resumed these operations at yearend across the St. Marys River at a new deposit near Boulougne, Fla. The company's zircon dry mill was still located at Folkston. Du Pont began constructing a new facility for producing Zircore, their popular new low-cost zircon-aluminum silicate foundry sand.

Ethyl Corp.'s planned operation for recovering heavy minerals, zircon, monazite, rutile, and ilmenite, from the McNairy formation in the vicinity of Kentucky Lake near Paris Landing, Henry County, Tenn. has met with opposition from local environmentalists. The company, by conducting tours through its pilot plant and mine site, was attempting to demonstrate to representative groups that the State's mining regulations will be complied with and that the operation will be both compatible and nonpolluting to the area.

Statistical data on production of zirconium sponge, ingot, and scrap and on hafnium sponge and oxide are also withheld to avoid disclosure of company confidential data. Approximately 2,500 tons of alloys containing from 3% to 70% zirconium was produced in 1974.

Three firms produced 36,400 tons of milled (ground) zircon, a decrease of 26% from the reported 1973 production. Six companies, excluding those that produce metal, produced 11,630 tons of zirconium oxide. Oxide production in 1974 decreased nearly 19% below that reported in 1973.

Hafnium crystal bar, produced by several firms, amounted to 40 tons, compared with 41 tons in 1973.

Table 2.—Producers of zirconium and hafnium materials in 1974

Company	Location	Materials
ZIRCONIUM MATERIALS		
AMAX Specialty Metals Corp	Akron, N.Y	Ingot, sponge.
Do	Parkersburg, W. Va	Sponge, metal chloride, oxide.
Babcock & Wilcox Co., Nuclear Materials Div	Parks Township, Pa	Powder, alloys.
Barker Foundry Supply Co	Los Angeles, Calif	Milled zircon.
The Carborundum Co	Falconer, N.Y	Refractories.
C. E. Refractories, Div. of Combustion Engineering, Inc.	St. Louis, Mo	Do.
	King of Prussia, Pa	Refractories, zircon.
Continental Mineral Processing Corp	Sharonville, Ohio	Milled zircon.
Corhart Refractories Co	Buckhannon, W. Va., Corning N.Y. and Louisville, Ky.	Refractories.
E. I. du Pont de Nemours & Co	Wilmington, Del	Zircon, foundry mixes.
Foote Mineral Co	Cambridge, Ohio	Alloys.
A. P. Green Refractories Co., Remmey Div	Philadelphia, Pa	Refractories.
Harbison-Walker Refractories	Mount Union, Pa	Do.
Harshaw Chemical Co., Inc	Cleveland, Ohio	Oxide, ceramics.
Hercules, Inc., Drakenfeld Div	Washington, Pa	Ceramic colors, milled zircon.
Ionarc/TAFA	Bow, N.H	Oxide.
M & T Chemicals, Inc	Andrews, S.C	Milled zircon.
Magnesium Elektron, Inc	Secaucus, N.J	Alloys, chemicals.
NL Industries, Inc., Titanium Alloy Manufacturing Div. (TAM).	Niagara Falls, N.Y	Milled zircon, oxide, alloys, chloride.
Charles Taylor Div	Cincinnati, Ohio	Refractories.
Do	South Shore, Ky	Do.
Norton Co	Huntsville, Ala	Oxide.
Ohio Ferro-Alloys Corp	Brillant, Ohio	Alloys.
Ronson Metals Corp	Newark, N.J	Baddeleyite (oxide).
Sherwood Refractories Co	Cleveland, Ohio	Zircon cores.
Shieldalloy Corp	Newfield, N.J	Welding rods, alloys.
Stauffer Chemical Co	Niagara Falls, N.Y	Chloride.
Teledyne Wah Chang Albany Corp	Albany, Oreg	Oxide, chloride, sponge, ingot, powder, crystal bar.
Titanium Enterprises, Inc	Green Cove Springs, Fla	Zircon.
Tizon Chemical Corp	Flemington, N.J	Oxide, chemicals.
Transelco, Inc	Dresden, N.Y	Chemicals, ceramics.
Union Carbide Corp	Alloy, W. Va., and Niagara Falls, N.Y.	Alloys.
Ventron Corp	Beverly, Mass	Alloys, oxide, sponge.
Zedmark, Inc	Butler, Pa	Refractories.
Zirconium Corp. of America	Cleveland, Ohio	Oxide, refractories, ceramics.
HAFNIUM MATERIALS		
AMAX Specialty Metals Corp	Akron, N.Y	Sponge, crystal bar, ingot, scrap.
Do	Parkersburg, W. Va	Oxide.
Babcock & Wilcox Co., Nuclear Materials Div	Leechburg, Pa	Crystal bar.
Teledyne Wah Chang Albany Corp	Albany, Oreg	Oxide, sponge, crystal bars, ingot.

CONSUMPTION AND USES

Zircon consumption in the United States in 1974 was estimated at 167,000 tons. Consumption of zircon concentrate and milled zircon was 80,000 tons for foundries, 40,000 tons of refractories, 15,000 tons for zirconium oxide, 1,600 ton for zirconium alloys (excluding zirconium-base alloys) and 30,400 tons for all other uses. Foundries consumed approximately one-half of the domestic zircon production; the remaining half was consumed by refractory, abrasive, ceramic, metal and other industries. Domestic zircon also was marketed in proprietary mixtures for use as weighting agents, zircon TiO_2 blends for welding rod manufacture, and zircon-refractory heavy mineral (kyanite, sillimanite, and staurolite) sand blends, for foundry sand, and sand-blasting applications. The zircon-bearing foundry sand was reportedly designed to provide consistent high-quality performance at low cost for critical casting applications.

Imported Republic of South Africa baddeleyite ore in 1974 was used principally in the manufacture of alumina-zirconia abrasives and also in ceramic colors, refractories, and for other uses.

Preliminary Bureau of the Census figures for 1974 showed that shipments of zircon and zirconia brick and shapes, composed mostly of these materials, totaled 2.7 million brick, expressed in terms of equivalent 9-inch brick, valued at $11.4 million. In 1973, final figures for shipments were 2.3 million brick valued at $8.3 million.[3]

Zirconium metal was used in nuclear reactors, in chemical plants for corrosion-resistant material, in refractory alloys, and in photography for flashbulbs. AMAX Specialty Metals ceased production of zirconium and hafnium sponge at its Parkersburg, W. Va., plant and zirconium and hafnium mill products at its Akron, N.Y., facility. The first commercial zirconium sponge production was begun at AMAX's New York facility in 1953. Stauffer Chemical Co., supplier of zirconium tetrachloride to zirconium and hafnium sponge producers, AMAX and Teledyne Wah Chang Albany Corp., also ceased production in 1974. Teledyne Wah Chang is currently producing zirconium tetrachloride from zircon at its Albany, Oreg., plant.

Zirconium Technology Corp. (Zirtech), Albany, Oreg., manufacturer of zirconium metal and alloy tubing, announced on December 30 that stockholders approved its merger as an operating division of Kawecki Berylco Industries, Reading, Pa.

Zirconium compounds, natural and manufactured, were used in refractories, glazes, enamels, welding rods, chemicals, and sandblasting. Zirconium chemicals were finding increased application in the paint, textile, and pharmaceutical industries.

Hafnium metal, alloys, and compounds continued to have few uses. The metal was used for nuclear reactor control rods, in special refractory alloys, and in photographic flashcubes. Nonnuclear hafnium metal uses were reportedly increasing.

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[3] U.S. Department of Commerce, Bureau of Census. Refractories. Quarterly, 1974.

Table 3.—Zircon consumption in selected zirconium materials as reported by producers in the United States in 1974

(Short tons)

Use	Quantity
Zircon refractories[1]	30,000
AZS refractories[2]	10,000
Zirconia[3]	15,000
Alloys[4]	1,600
Foundry aids	80,000
Other[5]	30,400
Total	167,000

[1] Dense and pressed zircon brick and shapes.
[2] Fused cast and bonded alumina-zirconia-silica-base refractories.
[3] Excludes oxide produced by zirconium metal producers.
[4] Excludes alloys above 90% zirconium.
[5] Includes chemicals, metallurgical-grade zirconium tetrachloride, sandblasting, and welding rods.

Table 4.—Zirconium oxide[1] consumption in selected zirconium materials as reported by producers in the United States in 1974

(Short tons)

Use	Quantity
AZ abrasives[2]	7,000
AZS refractories[3]	1,700
Other refractories	1,900
Chemicals	300
Glazes, opacifiers, and colors	730
Total	11,630

[1] Excludes oxide produced by zirconium metal producers.
[2] Alumina- and zirconia-based abrasives.
[3] Fused cast and bonded.

Table 5.—Yearend stocks of zirconium and hafnium materials

(Short tons)

Item	1973	1974
Zircon concentrate held by dealers and consumers, excluding foundries	43,200	35,400
Milled zircon held by dealers and consumers, excluding foundries	8,300	6,500
Zirconium:		
Oxide [1]	648	1,480
Sponge	520	771
Ingot	842	507
Scrap	840	1,124
Alloys	1,190	173
Refractories	9,895	9,584
Hafnium:		
Sponge	28	40
Crystal bar	10	10

[1] Excludes oxide held by zirconium metal producers.

PRICES

Published prices for regular grade domestic zircon rose from $60 to $250 per ton during the year. Foreign zircon rose from $140 to a high of nearly $600 per ton for certain grades. Prices of zirconium oxides either advanced or were unlisted for the entire year. The prices of zirconium chemicals and zirconium sponge and hafnium metal, sponge, and nitride were unchanged while zirconium powder and sheet prices advanced. The baddeleyite price, furnished by Ronson Metals Corp., also advanced during the year.

Table 6.—Published prices of zirconium and hafnium materials in 1974

Specification of material	Price	
Zircon:		
Domestic, f.o.b. Starke, Fla. (Folkston, Ga.), bags, per short ton [1]		$250.00
Domestic, 75% minimum quantity zircon and aluminum silicates, Starke, Fla. (Folkston, Ga.), bags, per short ton		NA
Imported sand, containing 65% ZrO_2, c.i.f. Atlantic ports, bags, per long ton		560.00
Domestic, granular, 30-ton lots, from works, bags, per ton [2]		440.00
Domestic, milled, 15-ton lots, from works, bags, per ton [2]		500.00
Baddeleyite, imported concentrate: [3]		
98% to 99% ZrO_2, minus 100-mesh, c.i.f. Atlantic ports, ton lots, per pound	0.18–	.20
99+%, minus 325-mesh, c.i.f. Atlantic ports, ton lots, per pound	.56–	.78
Zirconium oxide:		
Powder, commercial-reactor grade, drums, from works, per pound		NA
Chemically pure white ground, barrels or bags, works, per pound [2]		2.22
Electric fused, lump, bags, works, per pound		NA
Milled, bags, 5-ton lots, from works, per pound		NA
Glass-polishing grade, 100-pound bags, 85% to 90% ZrO_2, works, per pound [2]		1.11
Opacifier grade, 100-pound bags, 85% to 90% ZrO_2, per pound [2]		.81
Stabilized oxide, 100-pound bags, 91% ZrO_2, milled, per pound [2]		1.57
Zirconium oxychloride: Crystal, cartons, 5-ton lots from works, per pound [2]		.515
Zirconium acetate solution: [2]		
13% ZrO_2 drums, carload lots, from works, per pound		.22
22% ZrO_2, same basis		.38
Zirconium hydride: [2] Electronic grade, powder, drums, from works, per pound	14.50–	16.00
Zirconium: [4]		
Powder, per pound [4]		16.00
Sponge, per pound [1] [4]	5.50–	7.00
Sheets, strip, bars, per pound [1] [4]	12.00–	17.00
Hafnium: [4]		
Sponge, per pound		75.00
Bar and plate, rolled, per pound		120.00
Nitrided		34.25

NA Not available.

[1] Metals Week, v. 46, No. 1, Jan. 6, 1975, p. 4.

[2] Chemical Marketing Reporter, v. 206, No. 26, Dec. 23, 1974, p. 37.

[3] Ronson Metals Corp. Baddeleyite Price List. Jan. 1, 1974.

[4] American Metal Market, v. 81, No. 248, Dec. 24, 1974, p. 8.

FOREIGN TRADE

Exports of zirconium ore and concentrate and zirconium oxide were lower in 1974 than in 1973. Exports of all forms of zirconium metal and alloys, in general, rose in 1974 compared with those of 1973.

Zirconium ore and concentrate, exported to 14 countries in 1974, decreased from 57,842,328 pounds valued at $2,288,128 in 1973 to 42,973,250 pounds valued at $3,323,134. While the quantity exported was 26% below that shipped in 1973 the value rose over 45% to an alltime high. The average value of the zirconium ore and concentrate exported in 1974, $154.66 per ton, represented an increase from the 1973 value of $79.12. This increase was attributed more to the increasing value of zircon than to the larger amounts of higher cost granular and milled zircon shipped. The increase in the amount of higher cost zircon shipped indicated a return to the normal zircon exporting pattern. The major recipients of the exported zirconium ore and concentrate were the Netherlands, 42%; Mexico, 24%; Canada, 22%; Brazil, 4%; and Spain, 3%.

Exports of zirconium oxide totaled 2,055,000 pounds valued at $1,402,167 in 1973 compared with 1,816,497 pounds valued at $1,534,010 in 1974, a decline of 12% in quantity but a 9% increase in value. Zirconium oxide shipments were made to 22 countries. The five major recipients in 1974 were Mexico, 16%; Brazil, Canada, and France, 13% each; and the United Kingdom, 9%.

Total exports of other classes of zirconium increased over 62%, from 1,016,437 pounds in 1973 to 1,650,695 pounds in 1974. The value of this material rose 46% in 1974 to $18,194,996 from the 1973 value of $12,424,733. Of the categories listed, exports of wrought zirconium and zirconium alloys increased 40% in poundage and 48% in value, and those of unwrought and waste and scrap increased 188% in quantity and 73% in value. Zirconium and zirconium alloy foil and leaf exports decreased in both quantity and value in 1974, 13% and 12%, respectively.

Imports for consumption of zirconium ores in 1974 declined to 62,504 short tons, a 36% decrease compared with the 98,023 short tons in 1973. The 1974 figure represents the lowest tonnage of ore imported since 1968 (59,900 tons). Zirconium ore imports from the Republic of South Africa are chiefly baddeleyite (ZrO_2) and prior to 1974 were reported by the Bureau of Census under a separate category giving both quantity and value. Imports of this ore currently are reported under a basket category that reports total value only. It was estimated that approximately 2,950 short tons of South African baddeleyite was imported in 1974.

The average value of imported zircon at foreign ports increased nearly twofold in 1974 to $102.36 per short ton, compared with $51.76 in 1973.

Imports for consumption of zirconium and hafnium in 1974 decreased both in quantity and value in the following categories: Zirconium, wrought; and zirconium alloys, unwrought. Imports for consumption increased in quantity and value in the following categories: Zirconium, unwrought and waste and scrap; zirconium compounds, n.e.c.; hafnium, wrought; and hafnium, unwrought and waste and scrap. In the remaining zirconium oxide category, the quantity imported decreased while its value increased.

Table 7.—U.S. exports of zirconium ore and concentrate, by country

Destination	1973		1974	
	Pounds	Value	Pounds	Value
Argentina	10,400	$1,292	223,862	$41,683
Brazil	6,604,182	618,234	1,819,260	194,614
Canada	4,034,229	243,319	9,568,114	734,134
Chile	--	--	108,000	38,947
Colombia	6,000	1,786	--	--
France	26,880	5,240	--	--
Greece	--	--	2,000	750
Guatemala	118,400	6,079	--	--
Ireland	74,646	8,907	84,000	5,696
Italy	75,000	4,200	194,651	39,324
Jamaica	--	--	68,840	4,840
Japan	22,432,164	622,172	--	--
Korea, Republic of	--	--	200,000	29,212
Mexico	6,989,077	288,503	10,398,300	1,107,492
Netherlands	17,461,750	491,354	17,986,858	820,487
Peru	--	--	110,000	9,540
Spain	--	--	1,347,578	238,005
United Kingdom	2,000	1,065	861,787	58,410
Venezuela	12,600	977	--	--
Total	57,842,328	2,288,128	42,973,250	3,323,184

Table 8.—U.S. exports of zirconium, by class and country

Country	1973		1974	
	Pounds	Value	Pounds	Value
Zirconium and zirconium alloys, wrought:				
Argentina	--	--	435	$14,061
Australia	21	$563	--	--
Belgium-Luxembourg	16,177	581,474	51,653	1,677,740
Brazil	266	1,773	150	4,875
Canada	236,909	3,298,357	220,771	3,607,828
Denmark	112	1,208	--	--
France	13,016	439,210	7,661	84,576
Germany, West	213,515	1,788,895	394,815	3,592,618
India	4,234	38,794	--	--
Ireland	--	--	2,156	8,892
Israel	--	--	390	2,040
Italy	806	20,626	53,584	2,077,837
Japan	99,117	2,400,364	171,261	3,235,358
Mexico	--	--	200	1,664
Netherlands	1,068	8,313	16,005	156,217
Norway	6,144	59,541	9,103	83,981
Poland	48	570	--	--
Portugal	300	4,367	460	7,098
Romania	--	--	633	8,329
Spain	--	--	156	1,237
Sweden	70,932	684,688	43,627	312,166
Switzerland	15,132	724,127	--	--
United Kingdom	99,247	512,547	112,378	730,324
Total	777,044	10,565,412	1,085,438	15,606,841
Zirconium and zirconium alloys, unwrought and waste and scrap:				
Australia	23	536	--	--
Belgium-Luxembourg	3,241	38,660	--	--
Brazil	--	--	88	900
Canada	4,797	32,665	16,165	254,728
France	2,120	9,498	4,730	14,206
Germany, West	23,830	143,400	26,545	173,094
Haiti	336	1,746	--	--
India	37	1,203	--	--
Israel	--	--	237	13,446
Italy	451	10,900	--	--
Jamaica	--	--	254	1,140
Japan	32,206	252,009	250,741	347,163
Korea, Republic of	160	1,810	--	--
Mexico	--	--	140	882
Norway	3,275	31,936	618	2,769
Sweden	12,360	105,502	104,603	547,529
Switzerland	4,959	22,212	--	--
United Kingdom	89,765	465,822	107,213	582,100
Total	177,560	1,117,899	511,334	1,937,957
Zirconium and zirconium alloy foil and leaf:				
Belgium-Luxembourg	2,743	38,086	3,714	50,394
Canada	10,481	148,807	18,870	325,814
Colombia	--	--	28	530
France	--	--	88	704
Germany, West	39,045	440,653	2,842	40,347
Israel	47	558	123	1,468
Italy	5,995	78,020	6,684	121,317
Japan	2,432	23,724	4,983	12,850
Sweden	--	--	15,133	70,368
United Kingdom	1,090	11,574	1,458	26,406
Total	61,833	741,422	53,923	650,198

Table 9.—U.S. exports of zirconium oxide, by country

Country	1973		1974	
	Pounds	Value	Pounds	Value
Argentina	45,481	$40,949	99,488	$85,699
Australia	3,000	2,570	1,779	1,462
Austria	24,000	17,808	--	--
Belgium-Luxembourg	6,309	4,403	10,158	9,085
Brazil	144,993	102,024	234,187	199,267
Canada	277,165	186,959	244,100	168,450
Chile	400	592	1,250	1,850
Colombia	--	--	2,387	2,008
Dominican Republic	1,049	1,492	--	--
France	60,111	45,783	236,740	241,479
Germany, West	344,471	249,178	146,612	143,559
Greece	3,500	2,971	1,000	1,129
Hong Kong	7,450	6,858	3,000	3,000
Israel	600	546	1,000	1,269
Italy	17,491	17,186	77,605	62,268
Japan	652,999	400,236	139,106	97,799
Mexico	311,753	200,776	287,608	230,462
Netherlands	37,546	25,620	121,254	98,665
Peru	635	896	2,649	1,775
South Africa, Republic of	3,667	2,457	2,042	1,780
Sweden	--	--	23,362	15,921
Taiwan	--	--	8,000	7,280
United Kingdom	111,280	91,235	172,170	159,063
Venezuela	1,100	1,628	1,000	740
Total	2,055,000	1,402,167	1,816,497	1,534,010

Table 10.—U.S. imports for consumption of zirconium ores, by country

Country	1972		1973		1974	
	Quantity (short tons)	Value (thousands)	Quantity (short tons)	Value (thousands)	Quantity (short tons)	Value (thousands)
Australia	66,064	$3,081	90,353	$4,747	59,747	$6,031
Austria [1]	49	3	1	([2])	--	--
Canada [1]	844	49	1,179	82	1,054	90
Japan [1]	168	7	--	--	--	--
Malaysia	--	--	445	15	1,142	188
South Africa, Republic of	385	149	1,019	394	7	1
Thailand	--	--	--	--	554	88
United Kingdom [1]	--	--	5,003	175	--	--
Venezuela	27	2	23	2	--	--
Total	67,537	3,291	98,023	5,415	62,504	6,398

[1] Believed to be country of shipment rather than country of origin.
[2] Less than ½ unit.

Table 11.—U.S. imports for consumption of zirconium and hafnium, 1974

Country	Pounds	Value
Zirconium, wrought:		
France	127,754	$1,018,781
Germany, West	45	600
Total	127,799	1,019,331
Zirconium, unwrought and waste and scrap:		
Canada	25,936	15,895
France	43,778	78,629
Germany, West	108,696	141,704
Japan	386,835	1,217,369
Netherlands	7,039	11,011
Sweden	17,055	32,373
United Kingdom	14,759	25,819
Total	604,098	1,522,800
Zirconium alloys, unwrought: United Kingdom	1,100	1,908
Zirconium oxide:		
France	86	1,034
Germany, West	2,575	11,290
Japan	10,000	4,940
South Africa, Republic of	26,431	4,517
Switzerland	38	1,804
United Kingdom	72,861	43,173
U.S.S.R	198,278	171,763
Total	310,269	238,521
Zirconium compounds, n.e.c.:		
Australia	150,329	18,348
France	64,485	25,535
Germany, West	98,742	58,493
Netherlands	483	9,994
South Africa, Republic of	22,462	3,215
United Kingdom	4,024,901	1,471,874
Total	4,361,402	1,582,454
Hafnium, unwrought and waste and scrap: France	7,200	281,460
Hafnium, wrought: France	224	10,201

WORLD REVIEW

Australia leads the world in production of zircon, which is recovered from sand mining operations along its eastern coast (80%) and in Western Australia (20%). Production of zircon, a coproduct of rutile in east Australia, is expected to remain relatively constant due to lower grades and reserves coupled with persistent environmental problems. Substantial zircon reserves with coproduct ilmenite, on the other hand have been located in Western Australia that, when fully developed, will assure Australia's continuing role in world zircon markets.

Zircon sand is also produced in Brazil, the People's Republic of China, India, Malaysia, the Republic of South Africa, Spain, Sri Lanka, Thailand, and the U.S.S.R.

Baddeleyite is produced in the Republic of South Africa and Brazil and also is found in east Africa, Sri Lanka, and the U.S.S.R.

Australia.—A joint venture was considered between Ionarc/TAFA of Bow, N.H., producers of a plasma-made zirconia directly from zircon, and Associated Minerals Consolidated, Ltd. (AMA) for operating Ionarc's larger plasma furnace facility in eastern Australia.[4] AMA announced intentions to commission a new opacifier plant at Southport, 45 miles south of Brisbane, in early 1975.[5] Installation of new grinding equipment at Brisbane was also planned to treat zircon from its Dunwich operation on North Stradborke Island.

Murphyores Holdings Ltd. and Dillingham Mining Co., a division of Dillingham Construction Pty. Ltd., began site preparation for their jointly owned mineral sand operation on Fraser Island. Construction of a wet mill was planned for the island, over 100 miles off the Queensland coast, north of Brisbane, with the nonmagnetic rutile and zircon fractions to be barged to Maryborough on the mainland for dry milling. The partnership planned to produce 65,000 tons of combined zircon and rutile annually.[6]

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[4] Gadsden, P. D. H. Zirconium and Hafnium. Mining Annual Review, 1975. Min. J. (London), June 1975, pp. 99-100.

[5] Industrial Minerals. No. 78, March 1974, p. 29.

Du Pont (Australia) Ltd. and Allied Minerals NL, partners in Allied Eneabba Pty. Ltd., announced plant construction plans for full-scale mining of mineral sands in the Eneabba area, about 150 miles north of Perth. The decision was based on months of successful pilot plant operations at du Pont's Pigment Department for consumption in their plants. The other minerals, including zircon, rutile, leucoxene, monazite and kyanite, were to be sold on the open market.[7]

Western Mining Corp. Ltd. (WMC) acquired Black Sands Ltd. (BSC), the operation of which will now be carried out under the name of WMC Mineral Sands. The purchase provided WMC an opening into Western Australia's beach sand mining industry. BSC had planned to start developing deposits near Jurien Bay capable of producing up to 3.2 million tons of zircon, rutile, and ilmenite by the first half of 1975. A second deposit at Cooljarloo was reported to be as attractive as that of Jurien Bay.[8]

Consolidated Gold Fields Australia Ltd. (CGF) beach sand interests are held by two producers, Associated Minerals Consolidated (CGF interest 41%) operating on the east coast and Western Titanium N.L. (56%) on the west coast.[9] Western Titanium announced proven reserves of nearly 10 million tons of heavy minerals (double original estimates) at its Eneabba property. An earlier feasibility study detailed mining, engineering, and an analysis of the means of financing the new operation.[10]

Production of heavy mineral concentrates was scheduled by Mid-East Minerals NL, Ltd., in the Busselton Area (Western Australia) in the first part of 1975. Mid-East holds a one-third interest with Westralian Sands Ltd. holding two-thirds. Westralian will both process and sell the output and, to accommodate this new load, was planning extensions of its dry mill and shipping and handling facilities.[11]

Jennings Mining Ltd., a wholly-owned subsidiary of A. V. Jennings Industries (Australia) Ltd., began producing zircon, rutile, and ilmenite concentrates at its wet mill near Eneabba and dry separation plant at Geraldton, north of Perth.[12] Final plans for the Westralian Sands/Lennard Oil NL joint venture at Gingin would complete the picture of the new West Australian beach sands industry.[13]

Brazil.—Prospecting for mineral sands was undertaken by Mineral Deposits Ltd. of Australia and the Brazilian Nuclear Energy Commission. A joint venture between Ishihara Sangyo Kaisha Ltd. and C. Itoh & Co. Ltd. was established to develop unspecified heavy mineral sand deposits.

Canada.—Noranda Metals Corp. reaffirmed its intentions to construct a tube mill at Armprior to supply both nickel- and zirconium-base alloy tubing to the nuclear power industry.

Egpyt.—The main resource of zircon and other heavy minerals, chiefly ilmenite, magnetite, rutile, monazite, and garnet, were the black sands occurring at different localities along the Mediterranean coast. Reserves of these heavy minerals, over an explored area, were estimated at more than 4 million tons.[14]

Gambia.—A cooperative agreement was signed with the Government of Iceland to jointly establish a heavy minerals separation plant in Gambia and an ilmenite electrosmelting plant in Iceland. These plans were reportedly contingent on the outcome of feasibility studies underway and did not stipulate the disposition of the nonmagnetic rutile and zircon fractions.[15]

Guinea.—Renegotiations of concessions granted earlier were underway to expedite exploitation of Guinea's zircon- and ilmenite-rich beach sands.

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[6] Skillings' Mining Review. Rutile and Zircon Mining Planned in Australia. V. 63, No. 11, Mar. 16, 1974, p. 19.

[7] Engineering and Mining Journal. This month in Mining in the Pacific. V. 175, No. 1, January 1974, p. 148.

[8] European Chemical News. ECN Company News—In Brief. V. 26, No. 666, Dec. 13, 1974, p. 52.

[9] Mining Journal (London). Mining Annual Review, 1975. June 1975, p. 19.

[10] Mining Magazine (London). Australasia. V. 131, No. 4, October 1974, p. 321.

[11] Engineering and Mining Journal. In the Pacific-Australia. V. 175, No. 12, December 1974, p. 130.

[12] Mining Magazine (London). Australasia. V. 130, No. 3, March 1974, p. 149.

[13] Industrial Minerals (London). No. 86, November 1974, p. 28.

[14] Mining Journal (London). Mining Annual Review, 1975. North Africa and Middle East-Egypt. June 1975, p. 447.

[15] Mining Magazine (London). Highlights-Africa. V. 130, No. 3, March 1974, pp. 201–202.

India.—Indian Rare Earths Ltd. planned to establish a $45 million facility at Gopalpur in Orissa to recover and process the State's beach sand deposits. This Government-owned company completed an expansion at its Manavalakurichi plant in Tamil Nadu to 30,000 tons per year. Increases in zircon output were not specified.[16]

Table 12.—Zirconium concentrate: Non-Communist world production, by country

(Short tons)

Country	1972	1973	1974 p
Australia	r 393,187	393,336	406,648
Brazil	r 4,645	3,411	e 3,500
India	r e 5,500	r e 6,800	e 6,800
Korea, Republic of	14	25	44
Malagasy Republic	15	(1)	--
Malaysia [2]	r 1,820	3,463	3,035
South Africa, Republic of	r [3] 744	r [4] 5,463	[4] 13,208
Sri Lanka	33	31	23
Thailand	403	443	2,207
United States	W	W	W
Total	r 406,361	412,972	435,460

e Estimate. p Preliminary. r Revised. W Withheld to avoid disclosing individual company confidential data.

[1] Revised to zero.

[2] Exports (production not officially reported; exports believed to closely approximate total output).

[3] Production not officially reported; data presented are total recorded imports of zirconium ores and concentrates from the Republic of South Africa by the United States, Japan, and West Germany. As such, listed figure may be only a part of total output.

[4] Officially reported production.

Liberia.—A Dutch syndicate comprised of Wm. H. Muller N.V., Bos Kalis-Westminister Dredging Group and Hoogovens, and the Liberian Beach Sands Exploitation Co. continued its detailed exploration program in the southeastern part of the country for zircon, rutile, monazite, and ilmenite reserves. Bulk beach sand samples from selected areas have been shipped to Australia for combined mineral dressing and pilot plant tests.

Norway.—Plans for a $12 million "Norzon" (a zirconia-alumina abrasive manufactured from zircon, zirconia, and alumina mixtures) plant was announced by the Norton Co. The plant, scheduled for completion in 1976, is to be located at Evje on a 15-acre site.[17]

Sierra Leone.—Sierra Rutile Ltd., a group consisting of Bethlehem Steel International Corp. (85%) and Nord Resources Corp. (15%), successfully completed pilot plant tests on wet milling, geological work, and optimization of the mining method. The company concluded that commercial mining and milling could only proceed with suction dredging. Tests using dry mining methods, bucket wheel excavators, and dragline-dredge systems, were not promising. Detailed planning for production was underway.[18]

The Bayer-Preussag Mining Co., a joint venture of Bayer Aktiengesellschaft A. and Preussag A., both of West Germany, completed the first phase of exploration for heavy minerals in the Moyamba District of the Southern Province. Ore deposits containing fair amounts of rutile and heavy minerals were mapped, evaluated and sampled, and the firm was awaiting results from preliminary extractability tests prior to pilot plant investigations.

The Government's Geological Survey Div. was systematically examining other areas of black beach sands along the southern coast for ilmenite, monazite, and zircon.

South Africa, Republic of.—At Richards Bay, Quebec Iron & Titanium Corp. of Sorel, Canada (QIT), undertook feasibility studies with the Industrial Development Corp. of South Africa and Union Corp. QIT obtained a 50% interest in the project during the year and a decision is expected in 1975 if the scheduled annual production of zircon (125,000 tons per year), as well as rutile and titanium slag, will start in 1977 under the auspices of the new company—Tisand Pty. Ltd.

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[16] Mining Journal (London). Mining Annual Review. 1975. Rare Earths. June 1975. pp. 98–99.

[17] Industrial Minerals. No. 81, June 1974, p. 64.

[18] Mining Journal (London). Mining Annual Review, 1975. West Africa–Sierra Leone. June 1975, pp. 436–437.

Baddeleyite concentrates are produced at Phalaborwa, South Africa, by Phosphate Development Corp. Ltd. (FOSKOR) and by Palabora Mining Co. Ltd. (PMC) mining contiguous deposits in the Palabora igneous complex. These baddeleyite concentrates, pure (97% ZrO_2) and ultrapure (99+%), are coproducts from copper, phosphate, and iron operations, and were favorably received by the abrasive, ceramics, and refractory industries. Plant expansions are presently underway at both locations. The radioactivity associated with these baddeleyite concentrates, contaminating uranium and thorium mineralization, was readily removed by further combined pulverizing and acid treatment, resulting in the ultrapure 99+% grade.

Sri Lanka.—Expansion was still underway at the State Mineral Sands Corp. Pulmoddi heavy minerals operation 30 miles north of Trincomalee on the Bay of Bengal. Zircon production of 8,000 tons per year was targeted for 1976. Presently only very small quantities are produced.[19]

Tanzania.—A Government company, Beach Sands Mining Ltd. has been formed with Romanian partners to develop beach sand deposits on Tanzania's Indian Ocean coast. Heavy mineral production has already started on a pilot plant scale.[20]

Thailand.—Plans were announced by the S. A. Sands (Phuket) Co. to establish a beach sand mining operation at Prachuap Kiri Khan to produce 5,000 tons of zircon and 1,500 tons of rutile annually.[21]

United Kingdom.—Imperial Chemical Industries Mond Div. commenced production of its stabilized zirconia fibers, "Saffil," at Widnes in Lancashire.

TECHNOLOGY

The Office of Coal Research (OCR), U.S. Department of the Interior, announced granting of two major contracts under the July 1973 U.S.-U.S.S.R. Memorandum of Understanding involving joint research in magnetohydrodynamic (MHD)[22] electric generation[23] and cosponsorship of an international MHD conference.[24] In further MHD research, the OCR awarded contracts to university, industry, and government laboratories.[25]

The two major contracts were to provide the preliminary design of a channel to test the generation of electricity from coal by the MHD process in a Soviet pilot plant. The MHD conference scheduled for June 9–13, 1975 in Washington, D.C., is expected to draw MHD specialists and power engineers from all over the world, with the two largest contingents to come from the United States and the U.S.S.R. The conference is to emphasize three main topics: Open-cycle MHD systems; plasma closed-cycle MHD systems; and liquid metal closed-cycle MHD systems. All papers delivered at the conference are scheduled for publication in preprint volumes for distribution at the meeting.

Other MHD contracts of interest awarded by the OCR were research projects undertaken by the Massachusetts Institute of Technology (MIT), the University of Tennessee Space Institutes (UTSI), and the National Bureau of Standards (NBS). The MIT effort was to both provide technical advice to OCR on their MHD program and to coordinate an effective materials program. Candidate zirconia-based electrode and insulator materials and their relative advantages and disadvantages under various duct environments were identified. Protocols for testing these electrodes and insulator materials under seed and slag attack in bench scale and experimental duct scale were outlined, and a cooperative test program for these zirconia materials in the UTSI MHD duct under coalfiring conditions was organized.

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[19] Work cited in footnote 16.

[20] Industrial Minerals (London). No. 85, October 1974, p. 5.

[21] Mining Journal (London). Mining Annual Review, 1975. Far East–Thailand. June 1975, pp. 395–396.

[22] MHD involves generating electricity without the rotating parts associated with the less efficient conventional steam turbine generating systems. Coal-fired MHD systems are fired at high temperatures and pressures, and the resulting gases are forced through a duct at high velocities. The gases move through a magnetic field surrounding the duct, resulting in the generation of an electric current. The ultrahigh-temperature MHD systems are more efficient than lower temperature MHD systems and use stabilized zirconia electrodes and insulator materials in the ducts.

[23] U.S. Department of the Interior. OCR Announces First Major Contracts Under U.S.–U.S.S.R. Agreement. Press Release, Aug. 14, 1974, 1 p.

[24] U.S. Department of the Interior. OCR To Sponsor International MHD Conference. Press Release, Nov. 6, 1974, 1 p.

[25] U.S. Department of the Interior. Office of Coal Research, Annual Report 1973, Coal Technology: Key to Clean Energy. U.S. Government Printing Office, Washington, D.C., 1974, pp. 50–74 (Power Generation Systems).

The Energy Conversion Division of the UTSI, was working on the direct MHD conversion of coal to energy. This MHD generator was the only one in the world producing electric power using coal as a fuel. The program at NBS concerned high-temperature materials and consisted of coal slag characterization, vaporization studies, and electrical conductivity measurements of zirconia-based MHD electrode and insulator materials. The interactions of the various reaction products and noncombustibles resulting from coal combustion were also stressed in this work.

Bureau of Mines research efforts were directed toward lowering the cost of producing nuclear-grade zirconium and hafnium material, developing advanced refractory molybdenum-zirconium-hafnium alloys, and zircon desilication.[26] Research on reducing the production costs of nuclear-grade material centered on substituting an aliphatic amine technique for the conventional, more expensive and flammable methyl isobutyl ketone method of purifying zirconium by removing hafnium down to levels of 100 parts per million or less. This work has also shown that these amines were more completely recoverable than the ketone, which was inhibited by its slight water solubility. The advanced molybdenum-zirconium alloy research consists of three integrated phases: (1) Castability of alloys, (2) stable oxide coatings, and (3) casting oxidation resistance metal protective coatings. The compositions included in this research were TZM (Mo-0.5Ti-0.08Zr-0.015C) and binary molybdenum alloys containing various levels of zirconium and hafnium. Research on the stable oxide coatings was of particular interest. Spinel and perovskite structures were judged to be suitable candidates for oxidation-barrier coatings for these refractory alloys. In the highly important thermal expansion match between the coating and the alloy, studied experimentally with cross sections, spinels were closer than perovskites, and the chrome spinel variety, more closely matched than the aluminum type. This thermal expansion match with a chromium-bearing compound should greatly reduce bonding problems generally associated with mating oxides and alloys.

The Bureau also investigated possible methods for selectively removing the SiO_2 component of silicate minerals and ores. Methods were described for removing SiO_2 from selected zircon and aluminum ores as volatile silicon sulfides by treating with sulfur and carbon; with sulfur, carbon, and a reducing gas; or with sulfur compounds and carbon. Preliminary results should complete desilication of zircon at 1,450° C.

The geology, with particular emphasis on stratigraphy, heavy mineral suites, and ore body trends, of the Green Cove Springs and Boulougne heavy mineral sand deposits of Florida was published.[27] This work was done in close cooperation with the three domestic zircon producers: Titanium Enterprises, Inc., Humphreys Mining Co., and E. I. du Pont de Nemours & Co. A publication on the geology and mineral potential of South Vietnam indicated that much of the coastal areas contain zircon and other heavy mineral sands.[28] The area immediately north of Cam Rahn Bay in Thau-Thein Province appeared to be the most promising for zircon, monazite, and titaniferous mineral exploitation. The description and interpretation of an unusual occurrence of baddeleyite in the maficigneous rocks of the Canadian Arctic Archipelago were given.[29]

The presence of garnet-zircon-rutile, monazite, and ilmenite totaling nearly 50% of the heavy mineral fraction were found in the thin but persistent garnetiferous Northumbrian beach sands on the North Sea.[30] A reexamination of the extensive inland dune sands, on the other hand, appeared to merit further investigation of their heavy mineral potential. The use of large throughput dredges were advocated because of the less than 1% heavy minerals. The world zircon producers, led by Australia and the United States, their operations, and expansion plans were highlighted.[31]

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[26] Poppleton, H. O., and T. T. Campbell. Preliminary Investigation of Desilication of Minerals With Sulfur and Carbon. BuMines RI 7950, 1974, pp. 864–870.

[27] Pirkle, E. C., W. A. Pirkle, and W. H. Yoho. The Green Cove Springs and Boulougne Heavy-Mineral Land Deposits of Florida. Econ. Geol., v. 69, No. 7, November 1974, pp. 1129–1137.

[28] Hibb, D. H. The Mineral Potential of Viet-Nam. Min. Mag. (London), v. 131, No. 4, October 1974, pp. 297–303.

[29] Keil, K., and P. E. Fricker. Baddeleyite (ZrO_2) in Gabbroic Rocks From Axel Heiberg Island, Canadian Arctic Archipelago. Am. Miner., v. 59, Nos. 3–4, March–April 1974, pp. 249–253.

[30] Gallagher, M. J. Rutile and Zircon in Northumbrian Beach Sands. Trans. Inst. Min. Met. (Sec. B: Appl. Earth Sci.), v. 83, No. 813, August 1974, pp. B97–B98.

Shifts in the world's mineral supplies over the years were documented with selected minerals, such as Australian zircon.[32] Predictions of smaller demand, higher prices, and less waste were advanced. The availability of zircon supplies during the year, coupled with the ample supplies of chromite, their mutual substitutability in foundry applications, and their price comparability were explored.[33]

A novel hot Clerici-solution laboratory procedure for separating constituents of the nonmagnetic heavy mineral fraction, zircon, monazite, rutile, and spinel was described in a work analyzing the economic potential of Liberian beach sands.[34] The pumping of heavy minerals to the surface after concentration in a submerged hydrocyclone was studied with both a laboratory "micro-hydrocyclone" and a commercial unit.[35] This technique if commercially feasible would revolutionize the heavy mineral sands industry.

Richert cones, high-capacity rougher devices treating feeds between 2 millimeters and 350 mesh, have been known to have a limiting capacity above which the recovery drops off sharply. It was believed that this shortcoming, attributed to the inability of the slots to take a constant proportion of the solids at higher feed rates, has been overcome by a new slot profile. The cone's conventional sharp-edged adjustable slots were simply replaced with a new curved surface. Tests indicated that this new curved surface slot not only improved separation efficiency over a wide range of conditions but also wore better and did not block as readily.[36]

Work on plasma methods for producing zirconia from zircon,[37] zirconia or zirconium salts from zircon,[38] and zirconium and hafnium values also from zircon,[39] were described in patents. The plasma method for producing zirconia employs heating a finely divided zircon concentrate above its dissociation temperature, avoiding particle coalescence, to form extremely small zirconia crystallites and glassy amorphous silica. The hot dissociated zircon is quenched rapidly, and glassy silica is leached out with a sodium hydroxide solution leaving the insoluble zirconia crystallites. The production of either zirconia or a zirconium salt involves heating a stoichiometric mixture of limestone and zircon at a selected time and temperature to form calcium zirconate and tricalcium silicate clinker. The clinker is carefully cooled to first convert the tricalcium silicate to dicalcium silicate and lime. Further cooling results in the disintegration of the clinker into a very fine powder composed of dicalcium silicate and lime and coarser calcium zirconate crystals that are readily classified. The acid-soluble calcium zirconate crystals are treated with either acids or other reagents forming oxides or salts. The last patent outlines an elaborate procedure involving water slurrying the zircon with zinc oxide and phosphoric acid, treating with calcium carbonate, boiling with a sodium carbonate solution, all interspersed with decantation and washing steps. The separated solids are finally smelted to the base metal.

The investment casting industry, a large zircon sand and flour consumer, and its capability of delivering casting competitively with other metal forming techniques was detailed.[40] A table was also included depicting the industry's flexibility by listing cobalt and nickel base alloys, carbon and low steels (iron base), and selected miscellaneous ferrous alloys that are amenable to investment casting.

The manufacture of a novel unfired zircon-pyrophyllite refractory brick containing selected grain sizes of these two minerals bound with sodium silicate was patented.[41] This refractory brick should find wide application in modern steelmaking if it remains competitively priced. The refractory has excellent corrosion resistance at elevated temperatures to both molten steel and slags.

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[31] Industrial Minerals. World Zircon Producers: Australia and U.S. Still Dominate. No. 76, January 1974, pp. 13–16.

[32] Van Rensburg, W. C. J. Changing Patterns in the World's Supply of Minerals. Miner. Sci. Eng. (Johannesburg, South Africa), v. 6, No. 3, July 1974, pp. 142–153.

[33] Industrial Minerals. Zircon Shortage Bites: But Ample Supplies of Chromite. No. 76, January 1974, pp. 9–11.

[34] Rosenblum, S. Analyses and Economic Potential of Monazite in Liberia. J. Res. U.S. Geol. Survey, v. 12, No. 6, November–December 1974, pp. 679–682.

[35] Hayatdavoudi, A., R. W. Heins, and T. D. Tiemann. Researchers Look for Payoff in Hydroclone Processing of Marine Heavy Mineral Sand Deposits. Eng. and Min. J., v. 175, No. 6, June 1974, pp. 118–120.

[36] Woodcock, J T. Mineral Processing Progress in Australasia, 1973. Australian Min., v. 66, No. 8, August 1974, pp. 18–48.

[37] Scammon, L. W., Jr., C. L. Grant, and P. H. Wilkes (assigned to Humphreys Corp.). Processing of Silicate Ores and End Products Thereof. Ore. U.S. Pat. 3,811,907, May 21, 1974.

[38] Schoenlaub, R. A. Method of Manufacturing Zirconium Oxide and Salts. U.S. Pat. 3,832,-441, Aug. 27, 1974.

[39] Taylor, P. F. Process for Class IV B Metals Ore Reduction. U.S. Pat. 3,811,871, May 21, 1974.

[40] Iron Age. Investment Castings Find New Place in the Sun. V. 214, No. 10, Sept. 2, 1974. p. 52–57.

A brief manual on ceramic and refractory coatings and their applications in preventing either wear or corrosion was prepared.[42] The superior wear, refractory, and thermal insulation properties of the zirconium and hafnium borides, carbides, and oxides were noted. The manual only considered the four principal flame spray methods: (1) Oxyacteylene, (2) oxyhydrogen, (3) detonation, and (4) plasma.

A new family of lightweight, inorganic "Saffil" fibers, a yttria-stabilized zirconia and an alumina, was comprised chiefly of zirconia and alumina crystallites in the range from 50 to 500 angstroms.[43] These small crystallites lend strength to the fibers and when stabilized in a glassy and/or amorphous matrix, tend to inhibit both disruptive crystal phase transitions and crystallite growth at elevated temperatures. The zirconia fibers remain intact up to 1,600° C and resist attack by most acids and alkalies. Saffil will probably be used in thermal insulation, refractory surface repair, and filtration. The unusual characteristics of zirconia and yttria-thoria ceramics were being used as solid electrolytes in new approaches to oxygen measurement, hydrogen production, electric power generation, and air and water pollution control.[44] The unusual characteristics of these materials, dielectrical insulators at low temperatures but electrically conducting at elevated temperatures, can be further modified by controlling the type and amount of the stabilizers (calcia, yttria, or magnesia) used in their formulation.

The basic concepts for thermochemical hydrogen generation processes, including economic comparisons and uses, have been summarized.[45] A solid-membrane, open-cycle hydrogen generator, with a solid zirconia-bearing electrolyte, was reported to offer better potential for cheaper production of hydrogen than conventional electrolysis. The most important single barrier to new large-scale uses of hydrogen, for energy and chemical feedstocks, has been the high cost of hydrogen compared with other clean energy sources.

A comprehensive article dealt with the industrial importance of zirconium compounds.[46] The article discussed the fundamental properties and aqueous chemistry, the bonding between hydrous zirconium dioxide (HZD) and other substances, and the source of HZD. The hydrolysis and its implications along with the molecular structure of HZD were detailed in the aqueous chemistry section. The sources of HZD, zirconyl acetate and formate, ammonium and alkali metal zirconyl carbonates and the fluorozirconates, were afforded a similar detailed treatment. The superior bonding properties of HZD have found widespread application in the textile, paper, paint, polish, and cosmetic industries. The newer successful commercial applications for HZD compounds have been paper coating, polishes, emulsion paints, antiperspirants, and several textile finishing processes. The versatility of the HZD compounds is readily demonstrated by two applications. In paper coating and in polish formulations, a water-soluble zirconium compound is used to impart resistance to water and to improve film strengths. In the second application, for emulsion paints, zirconium compounds have been developed to impart reversible gel properties in nondrip paint.

A method of metal labeled stable isotope dilution (MLSID) has been developed that permits the ready determination of zirconium in geological samples.[47] Previous methods were both difficult and subject to large variations in reported zirconium concentrations.

Hydrozirconation was reported to be more desirable than many synthesis procedures employing hydroboration or hydroalumination.[48] The alkyl zirconium complexes used in hydrozirconation are less expensive, easier to prepare, and have higher organic product yields than their air-sensitive boron and aluminum analogs.

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[41] Nameishi, N., H. Yoshino, and S. Uto (assigned to Harima Refractories Co. Ltd.). Zircon-Pyrophyllite Unfired Refractory Bricks and Method for the Manufacture of the Same. U.S. Pat. 3,752,682, Aug. 14, 1973.

[42] Materials Engineering. Ceramic and Refractory Coatings. V. 80, No. 6, November 1974, pp. 101-108.

[43] Chemical and Engineering News. Technology-Inorganic Fibers Offer Unusual Properties. V. 52, No. 18, May 6, 1974, p. 29.

[44] Sproule, R. T. Zirconia and Yttria-Thoria Ceramics Find New Uses as Solid Electrolytes. Mater. Eng., v. 79, No. 1, January 1974, pp. 48-49.

[45] Wentorf, R. H., Jr., and R. E. Hanneman. Thermochemical Hydrogen Generation. Science, v. 185, No. 4148, July 26, 1974, pp. 311-319.

[46] Hock, A. L. Zirconium Compounds: The Industrial Importance of Their Aqueous Chemistry. Chem. & Ind. (London), No. 21, Nov. 2, 1974, pp. 864-870.

[47] Tsuge, S., J. J. Leary, and T. L. Isenhour. Stable Isotope Dilution Applied to the Determination of Zirconium in Geological and Lunar Samples. Anal. Chem., v. 46, No. 1, January 1974, pp. 106-110.

A novel isostatic hot pressing system, without molds, was successful in eliminating residual porosity normally associated with sintered lanthanum-modified lead zirconate-lead titanate (PLZT) polycrystalline ceramics.[49] This pressing method, with the pressure transmitted with inert gases, requires lower pressures (50 to 200 bars) and temperatures (usually 1,000° C lower) than conventional PLZT sintering temperatures. Pore-free ceramics, which have been densified to virtually theoretical density, with their number continually increasing, find use in transparent PLZT ceramics for electrooptics, as well as piezoelectrical ceramics based on PZT for surface wave filters. Fabrication of translucent PLZT ceramics by conventional hot pressing[50] and a technique for determining the temperature sensitivity on the electrooptic effects and dielectric constants have been outlined[51] in articles. In related PLZT work, a new ceramic window has been developed for airplanes, which, when electrically activated, switches from transparent to opaque.[52]

The fracture toughness of partially stabilized ZrO_2 (PSZ) was related to a simple correction factor.[53] PZS ceramics and refractories are superior in thermal shock properties to conventional fully stabilized zirconia. Thermal shock structures of PSZ in the binary system CaO-ZrO_2 were studied.[54] The brittleness of a thermally shocked specially prepared batch, due to extensive microcracking, was thought to arise from both the large volume of the monoclinic ZrO_2 present and from the hardness of the host cubic ZrO_2 matrix. In another work on PSZ, the role of SiO_2 in commercial ZrO_2 products were investigated.[55] Silica enhanced the sintering of zirconia partially stabilized with either CaO or MgO but contributed to increased fired shrinkage. The possible mechanisms of sintering enhancement and the concentration of the stabilizer and the SiO_2 impurity at the grain boundaries were also discussed.

Heating dehydrated amorphous ZrO_2 and subsequent study by X-ray and electron diffraction, and Raman scattering revealed the presence of an induced metastable tetragonal ZrO_2 followed by conversion to the stable monoclinic ZrO_2 phase.[56] This definitive study with Raman scattering measurements, a technique sensitive to intermediate-range order, has succeeded in explaining the crystallization sequence of amorphous zirconia mixtures obtained during commercial drying steps. In a related work, the crystallization sequence was further refined and attributed to 2 weight-percent OH- ions, which were concentrated on the ZrO_2 surfaces, domain boundaries, and occasionally in the lattice.[57]

The directional solidification (DS) of the ZrO_2-MgO eutectic has been studied thoroughly.[58] The eutectic composition was located at 27 weight-percent MgO with DS of this composition yielding MgO rods in a cubic ZrO_2 matrix. Annealed compositions, 24 hours at 1,200° C, increased in fracture strength by 50% over their unannealed room-temperature counterparts. The control of microstructure and design of ceramic materials has been the subject of considerable research, with the objective of maximizing a particular mechanical, optical, electrical, magnetic, or other property. DS has been investigated extensively in metallurgical systems. The formation of $CaZrO_3$, a major sinter product in the limestone-zircon process for ZrO_2 production, in the solid state has been researched.[59] The compatibility relations in the system SiO_2-ZrO_2-P_2O_5, which includes the ore mineral zircon, and zirconium chemicals used in ceramic and refractory manufacturing, was established by quenching, annealing, X-ray diffractometry, and optical microscopy.[60]

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[48] Chemical and Engineering News. Hydrozirconation Is a Good Synthesis Route. V. 53, No. 15, Apr. 14, 1975, p. 15.

[49] Hardtl, K. H. Gas Isostatic Hot Pressing Without Molds. Bull. Am. Ceram. Soc., v. 54, No. 2, February 1975, pp. 201–207

[50] Ishitobi, Y., M. Shimada, and M. Koizumi. Fabrication of Translucent Pb $(Zr0._5Ti0_2)$ 0_3 Ceramics by Isostatic Hot-Pressing J. Am. Ceram. Soc., v. 57, No. 10, October 1974, p. 458.

[51] Kaplit, M., and D. S. Eddy. Temperature Dependence of the Birefringence for PLZT 7/65/35 and an Nb-Modified PZT. J. Am. Ceram. Soc., v. 57, No. 9, September 1974, p. 409.

[52] Industry Week. Emerging Technologies—New Ceramic Windows. V. 184, No. 4, Jan. 27, 1975, p. 26.

[53] Green, D. J., and P. S. Nicholson. Correlation of Work-of-Fracture and Fracture Toughness for $Zr0_2$ Partially Stabilized by CaO. J. Am. Ceram. Soc., v. 57, No. 2, February 1974, pp. 105–106.

[54] El-Shiekh, A. M., and P. S. Nicholson. Thermal Shock Structures in a Partially Stabilized ZrO_2 in the System CaO–ZrO_2. J. Am. Ceram. Soc., v. 57, No. 1, January 1974, pp. 19–22.

[55] Shackelford, J. F., P. S. Nicholson, and W. W. Smeltzer. Influence of SiO_2 on Sintering of Partially Stabilized Zirconia. Bull. Am. Ceram. Soc., v. 53, No. 12, December 1974, pp. 365–367.

[56] Keramidas, V. G., and W. B. White. Raman Scattering Study of the Crystallization and Phase Transformations of ZrO_2. J. Am. Ceram. Soc., v. 57, No. 1, January 1974, pp. 22–24.

[57] Mitsuhashi, T., M. Ichihara, and U. Tatsuki. Characterization and Stabilization of Metastable Tetragonal ZrO_2. J. Am. Ceram. Soc., v. 57, No. 2, February 1974, pp. 97–101.

[58] Kennard, F. L., R. C. Bradt, and V. S. Stubican. Directional Solidification of the ZrO_2–Mg Eutectic. J. Am. Ceram. Soc., v. 57, No. 10, October 1974, pp. 428–431.

The AMAX Zr-Hf Newsletter, devoted to abstracting zirconium and hafnium technology, ceased publication with its August 1974 issue.[61] Many of the articles were devoted to the production and use of zirconium and hafnium as compounds, as metal alone, in alloys and as alloying elements, not only in nuclear applications but also in refractory and oxidation- and corrosion-resistance technology.

A carbothermic reduction method for the production of zirconium metal from its oxides was patented.[62] The method involves reacting the oxide with carbon in a molten metal solvent, preferably tin, copper, or iron, forming carbon monoxide and free metal in solution with the solvent. In an embodiment, the reduction in a nitrogen atmosphere forms a metal nitride that can be further processed by the molten metal solvents. The pure metals in solution can be recovered by conventional phase separation methods. This new process was expected to lower the price of commercial- and nuclear-grade zirconium metals and alloys.[63]

A new alloy, known as zirconia grain stabilized (ZGS) platinum was reported to be stronger and more creep resistant than the conventional high-temperature rhodium-platinum alloys.[64] ZGS platinum was expected to replace conventional platinum alloys where high-temperature strength is required. Optical glass stirrers and glass holding bowls were two uses cited. Another new alloy, applicable in gas turbine engines, using directionally solidified eutectic techniques was announced.[65] This nickel-base wrought-type alloy contains hafnium and zirconium.

The improved corrosion resistance of metal systems containing small amounts of added zirconium were investigated by Auger electron spectroscopy.[66] The breakdown by oxidation of the protective zirconium carbide or nitride skin, formed during metalworking, was observed starting as low as 500° C with the zirconium degassing as an oxide above 1,500° C. The use of standard free energy data and phase equilibria predicted the compounds formed on adding the rare-earth elements and zirconium metal to steel.[67] The rare-earth and zirconium oxides, strong steel deoxidants, were desirable because their high melting points allowed sufficient retention time to be effective. The use of zirconium and selected desulfurizers in improving the formability of high-strength, low alloy (HSLA) steels was discussed. HSLA steels are used in drilling rigs and in pipelines.

The hardness of the refractory ZrB_2 and HfB_2 was studied at elevated temperatures.[68] These hard and brittle room-temperature compounds decreased in hardness with increasing temperature. The studies conducted with a high-temperature microscope specially equipped with a microhardness tester were correlated with the unit cell dimensions of the diborides determined by X-ray diffractometry. The authors suggested that the microhardness and X-ray techniques were more reliable since the information affecting the microstructure, such as grain size and porosity were rarely provided.

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[59] Angers, R., R. Tremblay, and A. C. D. Chaklader. Effect of Pressure on Formation of $CaZrO_3$ by Solid State Reaction Between CaO and ZrO_2. J. Am. Ceram. Soc., v. 57, No. 5, May 1974, pp. 231–232

[60] Mason, T. O., and F. A. Hummel. Compatibility Relations in the System SiO_2–ZrO_2–P_2O_5. J. Am. Ceram. Soc., v. 57, No. 12, December 1974, pp. 538–539.

[61] AMAX Specialty Metals Corporation, Metals Division. Zr–Hf Newsletter. Akron, N.Y., August 1974, 17 pp.

[62] Anderson, R. N., and N. A. D. Parlee (assigned to Parlee-Anderson Corp.). Carbothermic Reduction Method for Converting Metal Oxides to Metal Form. U.S. Pat. 3,794,482, Feb. 26, 1974.

[63] American Metal Market. New Process May Reduce Some Zirconium Tags. V. 81, No. 133, July 20, 1974, 1 p.

[64] Materials Engineering. Metals News: Stabilized Platinum Minimizes Creep. V. 80, No. 2, August 1974, p. 18.

[65] Industry Week. Emerging Technologies: A New Nickel-Base Superalloy. V. 181, No. 9, May 27, 1974, p. 24.

[66] Joshi, A., M. N. Varma, and M. Strongln. Surface Segregation and Interaction of Oxygen and Nitrogen With Zirconium in Nb–1% Zr. Alloy. Met. Trans., v. 5, No. 4, April 1974, pp. 861–863.

[67] Wilson, W. G., D. A. R. Kay, and A. Vahed. The Use of Thermodynamics and Phase Equilibria To Predict the Behavior of the Rare-Earth Elements in Steel. J. Metals, v. 26. No. 5, May 1974. pp. 14–23.

[68] Bsenko, L., and T. Lundstrom. The High-Temperature Hardness of ZrB_2 and HFB_2. J. Less-Common Metals, v. 34, No. 2, February 1974, pp. 273–278.

The scientific and technical information presented at the symposium on zirconium in nuclear application sponsored by the American Society for Testing and Materials, Portland, Oreg., in August 1973 were published.[69] The broad topics covered were test methods and specifications, plastic deformation, texture phenomenon, irradiation effects on structure and creep irradiation effects on strength and fracture behavior, and corrosion.

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[69] American Society for Testing and Materials. Zirconium in Nuclear Application. ASTM-AIME Symp., Portland, Oreg., Aug. 21-24, 1973, ASTM Spec. Tech. Pub. 551, Philadelphia, Pa., 1974, 526 pp.

Minor Metals

By Staff, Division of Nonferrous Metals

CONTENTS

	Page
Arsenic	1417
Cesium and rubidium	1419
Germanium	1421
Indium	1422
Radium	1423
Scandium	1424
Selenium	1425
Tellurium	1429
Thallium	1432

ARSENIC [1]

Legislation and Government Programs.—As a result of studies indicating a possible correlation between arsenic exposure and cancer frequencies, meetings were held in September to consider new standards of allowable arsenic concentration in the air. The Occupational Safety and Health Administration (OSHA) scheduled an informal public hearing for early 1975 on recommendations for exposure standards for inorganic arsenic.

Domestic Production.—Arsenic trioxide (As_2O_3) was produced domestically only at the Tacoma, Wash., copper smelter of American Smelting and Refining Company (ASARCO Incorporated). Production data cannot be published. Output was adversely affected by a month-long strike and was 27% below that in 1973. Shipments were the largest since 1945 and were more than double production. As a result, stocks at yearend were 78% less than those at the beginning of 1974 and the lowest since 1968.

Consumption and Uses.—Apparent consumption of arsenic, essentially all as white arsenic (As_2O_3), increased 15% over that in 1973. Calcium and lead arsenate were the principal end products. Minor quantities of arsenic were used in sodium arsenate and other chemical compounds.

Production data on calcium arsenate may not be published but usage, as measured by disappearance at the domestic producers level, was 650 tons in 1973 compared with 876 tons in 1972. Lead arsenate production totaled 1,973 tons in 1973, 24% less than that in 1972. Disappearance for all domestic uses was 1,503 tons, down 40% from that in 1972.

Arsenical compounds used in wood preservatives continued as an important use of arsenic. Consumption of chromated copper arsenate (CCA compounds) increased for the sixth consecutive year; 5,834 tons, 20% more than that in 1972, was consumed in 1973. The use of fluor chrome arsenate phenol (Wolman salts and osmosalts), on the other hand, has trended downward since 1969. Consumption of 842 tons in 1973 was 12% less than that in 1972.

Small quantities of high-purity arsenic were used in the manufacture of gallium and indium arsenides for semiconductors.

Prices.—The price of refined white arsenic, 99.5%, at New York docks, was quoted at 6 to 6¾ cents per pound at the beginning of 1974. On January 24, the price was 6½ cents per pound which held through yearend. Refined white arsenic at Laredo was $165 per ton in early 1974, rose to $210 per ton on June 3, and remained at this level throughout the remainder of 1974.

Arsenic metal was quoted in London at

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[1] Prepared by Gertrude N. Greenspoon, mineral specialist.

£800 to £1,000 per metric ton (87.1 to 108.9 cents per pound) until February 19 when it rose to £1,500 to £2,000 per metric ton (163.3 to 217.7 cents per pound) where it remained throughout yearend.

Foreign Trade.—No exports of arsenic metal or white arsenic were reported.

Imports of white arsenic rose 2% over those of 1973. Sweden, the principal supplier, furnished 50% and Mexico supplied 45% of the total receipts. Of the 25 pounds of arsenic sulfide imported, all came from the United Kingdom; 84,700 pounds of arsenic compounds were received in 1974, most of which came from the United Kingdom, and most of the 266,000 pounds of sodium arsenate also came from the United Kingdom.

Receipts of arsenic metal were 707 tons, 10% more than in 1973. Sweden supplied 605 tons, the People's Republic of China 50 tons, Canada 31 tons, and West Germany 21 tons. Less than 1 ton each was received from Japan, the Netherlands, Switzerland, Belgium-Luxembourg, and the United Kingdom.

Tariff.—Arsenic oxide (white arsenic) enters the United States duty free. A 1.2-cent-per-pound duty was applicable to arsenic metal.

Table 1.—U.S. imports for consumption of white arsenic (As_2O_3 content), by country

Country	1972		1973		1974	
	Quantity (short tons)	Value (thousands)	Quantity (short tons)	Value (thousands)	Quantity (short tons)	Value (thousands)
Australia	--	--	21	$3	--	--
Belgium-Luxembourg	1	$7	--	--	--	--
France	1,556	184	1,281	190	480	$90
Germany, West	11	4	11	4	--	--
Mexico	3,552	462	5,605	760	6,185	1,084
Peru	24	27	25	1	24	1
South Africa, Republic of	285	44	409	50	145	29
Sweden	8,184	1,228	[r] 6,144	[r] 1,037	6,889	1,284
United Kingdom	--	--	--	--	19	11
Total	13,613	1,956	[r] 13,496	[r] 2,045	13,742	2,449

[r] Revised.

Table 2.—U.S. imports for consumption of arsenicals, by class
(Thousand pounds and thousand dollars)

Class	1972		1973		1974	
	Quantity	Value	Quantity	Value	Quantity	Value
White arsenic (As_2O_3)	27,226	1,956	[r] 26,992	[r] 2,045	27,484	2,449
Metallic arsenic	1,331	1,790	1,286	2,630	1,414	3,651
Sulfide	2	(1)	5	414	(1)	(1)
Sodium arsenate	479	69	526	74	266	52
Arsenic compounds, n.e.c	(1)	19	(1)	21	85	55

[r] Revised.
[1] Less than ½ unit.

World Review.—World production of white arsenic rose 7% in 1974. A nearly twofold increase in output in Mexico more than offset a 19% decrease in South-West Africa. Production in other countries was little changed from previous years.

Technology.—Research conducted by ASARCO indicated that arsenic metal can be used to improve cast iron strength[2] and this development apparently was a factor in the decision for the startup of a new facility at Tacoma to produce metallic arsenic. Also, at Tacoma construction was underway on a new system for handling arsenic-bearing dust.

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[2] American Metal Market. Asarco Making Metallic Arsenic Following Copper Strike Delay. V. 81, No. 171, Sept. 2, 1974, p. 48.

Table 3.—White arsenic (arsenic trioxide):[1] World production by country

(Short tons)

Country[2]	1972	1973	1974 p
Brazil	181	76	85
Canada	30	--	--
France	8,423	r e 9,000	e 9,000
Germany, West	491	e 520	e 470
Japan	471	e 500	213
Mexico	r 6,523	5,606	10,477
Peru	1,123	1,528	e 1,550
Portugal	15	22	--
South-West Africa, Territory of[3]	2,612	8,981	7,319
Sweden	17,857	16,755	e 17,600
U.S.S.R e	7,940	7,990	8,050
United States	W	W	W
Total	45,666	50,978	54,764

e Estimate. p Preliminary. r Revised. W Withheld to avoid disclosing individual company confidential data.

[1] Including calculated arsenic trioxide equivalent of output of elemental arsenic and arsenic compounds other than white arsenic, where inclusion of such materials would not duplicate reported white arsenic production.

[2] In addition to the countries listed, Austria, Belgium, the People's Republic of China, Czechoslovakia, East Germany, Finland, Hungary, Southern Rhodesia, the United Kingdom, and Yugoslavia have produced arsenic and/or arsenic compounds in previous years but information is inadequate to ascertain whether such production has continued or not, and if so, at what levels.

[3] Output of Tsumeb Corp. Ltd. only.

A report summarizing the abundance and distribution of arsenic in soils and other surface materials throughout the United States indicated that the average for the entire U.S. was 5.8 parts per million. The average for the Western States was 6.1 parts per million and for the Eastern States 5.4 parts per million. Clusters of high values appeared in the central part of the Cordilleran Mountain region, the Ozark region, and parts of the Appalachian Highland region that may reflect the arsenic content of the parent geologic materials.[3]

CESIUM AND RUBIDIUM[4]

Domestic Production.—There was no domestic production of cesium- and rubidium-bearing minerals during 1974. The likelihood of any future domestic production of such minerals remained poor. Imported pollucite was the source of domestically produced cesium and its compounds. A residue from the processing of lithium ores in previous years known as *ALKARB* provided the source of domestically produced rubidium and its compounds.

Total production of cesium chemical compounds increased significantly in 1974, and production of rubidium chemical compounds declined by more than one-half of that of 1973.

The following companies produced cesium and rubidium chemicals during the year: Kawecki Berlyco Industries, Inc., Revere, Pa.; Kerr-McGee Corp., Trona, Calif.; and Great Western Inorganics, Inc. (formerly Rocky Mountain Research, Inc.), Golden, Colo. No production of cesium and rubidium metal was reported, but small quantities of both metals were shipped from existing stocks.

Consumption and Uses.—Data, relating to the consumption and end use pattern of cesium and rubidium metals and compounds, were not available. These materials found commercial application in the manufacture of pharmaceuticals, ultracentrifuge separation of organic compounds, and electronic apparatus such as scintillation counters, photomultiplier tubes and photoelectric cells. Cesium, rubidium, and their compounds can be substituted for each other in some end uses.

The Office of Coal Research, U.S. Department of the Interior, continued to fund magnetohydrodynamic (MHD) electric generation research. If MHD electrical generation is successfully developed in this decade demand for cesium may be generated to enhance MHD plasma.

Prices.—During the year the American Metal Market quoted a nominal price for pollucite containing about 20% cesium

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[3] Shacklette, H.T., J.G. Boerngen, and J.R. Keith. Selenium, Fluorine, and Arsenic in Surficial Materials of the Conterminous United States. U.S. Geol. Survey Circ. 692, 1974, pp. 10-11.

[4] Prepared by Benjamin Petkof, physical scientist.

(Cs), in minimum lots of 10 tons delivered to an entry point, at $300 per short ton. At yearend the Metal Bulletin quoted the nominal price for pollucite concentrates containing a minimum 24% Cs_2O, f.o.b. source, at $12.40 to $13 per metric ton unit (22.046 pounds of Cs_2O).

The American Metal Market quotation on cesium metal, 99+% purity remained unchanged at $100 to $375 per pound. The quotation on rubidium metal, 99.5% purity, also remained unchanged at $300 per pound.

Table 4.—Prices of selected cesium and rubidium compounds in 1974

Item	Base price per pound[1]	
	Technical grade	High-purity grade
Cesium bromide	$28	$65
Cesium carbonate	29	67
Cesium chloride	30	68
Cesium fluoride	35	75
Cesium hydroxide	35	75
Rubidium carbonate	45	75
Rubidium chloride	46	76
Rubidium fluoride	51	83
Rubidium hydroxide	51	83

[1] Excludes packaging cost, 50- to 100-pound quantities, f.o.b. Revere, Pa.

Source: Kawecki Berylco Industries, Inc.

Foreign Trade.—Pollucite import data were not available. However, reported receipts by consumers indicate that pollucite was imported. It was likely that most of the pollucite consumed in the United States was imported from Canada.

Imports of cesium compounds increased from 3,159 pounds valued at $111,631 in 1973 to 4,622 pounds valued at $167,965 in 1974. There were no reports of cesium and rubidium metal imports during the year. No other data were available on imports or exports of cesium or rubidium products.

World Review.—In May 1974 Kawecki Berylco Industries, Inc., acquired 24.9% of the stock of the Tantalum Mining Corp. of Canada (TANCO) at Bernic Lake, Manitoba, Canada. TANCO has the world's only commercial source of pollucite. By participation in TANCO operations Kawecki Berylco Industries, Inc., has access to a viable commercial source of raw cesium ore.

Technology.—Increasing scientific and engineering interest in development and commercialization of MHD techniques for electric power generation in the United States and the U.S.S.R. may lead to future commercial use of cesium oxide. In July 1973 the United States and the U.S.S.R. signed a memorandum of understanding for joint research in MHD electric generation.

Table 5.—U.S. imports for consumption of cesium compounds in 1974, by country

Country	Cesium chloride		Cesium compounds, n.s.p.f.	
	Pounds	Value	Pounds	Value
France	--	--	982	$11,371
Germany, West	2,038	$92,495	1,463	59,924
United Kingdom	110	3,523	29	652
Total	2,148	96,018	2,474	71,947

GERMANIUM [5]

Production and consumption of germanium showed no significant changes in 1974 from those since 1970. A few of the domestic consumers designed germanium out of some of their electronic systems, but at the same time, the use of germanium in optics increased to recover that part of the lost semiconductor market.

Domestic Production.—Production of germanium from domestic sources was estimated at 28,000 pounds in 1974. Germanium was a minor byproduct of ores mined for zinc. No new residues were being recovered from the Kansas-Missouri-Oklahoma zinc-bearing region, and no mines were operated solely for recovery of germanium. Recycled waste or new scrap obtained from the manufacture of semiconductors supplemented the domestic supply. In addition, first reduction metal or scrap was imported and refined.

Eagle-Picher Industries, Inc., of Quapaw, Okla., was the sole U.S. producer of primary germanium in 1974. The company extracted germanium from the stockpile of zinc smelter residues at its plant at Quapaw, and it also reprocessed scrap. Other processors of secondary germanium and imported metal were GTE Sylvania Inc., Towanda, Pa.; Kawecki Berylco Industries, Inc., Revere, Pa.; and Atomergic Chemetals Co., Carle Place, Long Island, N.Y. GTE Sylvania discontinued its germanium producing operation at yearend and sold its equipment and technology to Texas Materials Laboratory, Garland, Tex.

Consumption and Uses.—The major end use for germanium has been in semiconductors such as transistors, diodes, and rectifiers. While the overall requirement for semiconductors has increased, the demand for germanium in this end use has declined, as shown in table 6.

Since germanium has a high refractive index, it found its way into numerous optical applications. Germanium is opaque in the visible region of the spectrum but transparent to the infrared region. This property made it useful as windows and lenses. Optical systems containing germanium were used in microscopes, surveillance devices, aerial photography, and medical devices. Specially doped germanium crystals were also used as infrared detectors.

Table 6.—Market estimates of semiconductor shipments
(Million dollars)

	1972	1973	1974	1975	1978
Transistors, bipolar:					
Germanium	35	30	28	22	12
Silicon	294	366	404	390	416
Signal diodes:					
Germanium	5	4	3	3	1
Silicon	48	44	45	40	31
Other categories	1,142	1,654	1,987	2,103	3,079
Total semiconductors	1,524	2,098	2,467	2,558	3,539

Source: Electronics. U.S. Markets 1975. V. 48, No. 1, Jan. 9, 1975, pp. 82–102.

Germanium was used for gamma ray detection, principally for nuclear research, activation analysis, and medical applications. Germanium was used in various alloys, in brazing or soldering material, in corrosion-resistant, high-strength zirconium alloys, in beryllium alloys to improve ductility, and in gold alloys for precision casting. Some petroleum refining operations and processes for the production of polyester fibers employed germanium catalysts.

Other uses for germanium were in X-ray equipment, fluorescent lamps, strain gages, batteries, superconductor materials, nodular cast iron, and biological organogermanium compounds.

Prices.—The prices of domestic zone-refined (intrinsic) germanium and domestic germanium dioxide were $293 and $167.50 per kilogram, respectively, through 1974. These prices were in effect since June 8, 1970. Imported germanium prices increased on February 1, 1974, to $275 per kilogram for germanium metal and $145.50 per kilogram for germanium dioxide. The previous prices were $260 and $136 per kilogram, respectively.

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[5] Prepared by Herbert R. Babitzke, physical scientist.

Foreign Trade.—U.S. imports of germanium metal (unwrought, and waste and scrap) totaled 14,099 pounds valued at $1,014,801 in 1974, a decrease in quantity of 4% from that of 1973. Italy supplied 46% of the germanium imports, the U.S.S.R. supplied 20%, and the Netherlands, 11%. The value of imports varied considerably among countries, from $24 per pound in Italy to $1,277 per pound in Belgium-Luxembourg. This suggests that the germanium from Belgium-Luxembourg was high-purity single crystal, while the low-valued material was probably concentrates or scrap.

Table 7.—U.S. imports for consumption of germanium in 1974, by country

Country	Quantity (pounds)	Value
Unwrought, and waste and scrap:		
Belgium-Luxembourg	291	$371,472
France	291	16,638
Germany, West	1,010	59,945
Italy	6,489	158,328
Netherlands	1,540	112,697
South Africa, Republic of	1,074	78,219
United Kingdom	540	48,068
U.S.S.R	2,864	179,434
Total	14,099	1,014,801

World Review.—World production of primary germanium was estimated at 168,000 pounds in 1974. The main producing countries were the United States, Japan, Belgium-Luxembourg, and Italy. No production data were available on a country by country basis.

Technology.—Research continued on the development of organogermanium compounds as polymers and therapeutic agents. Certain compounds showed promise in the treatment of carcinoma and leukemia. Development continued on platinum-germanium catalysts, whose principal use is in the conversion of hydrocarbons, particularly in the reforming of the gasoline fraction.

Progress was made toward the production of a practical columbium-germanium superconductor. A technique called sputtering was used to lay a film of columbium-germanium atoms on a strip of sapphire. The film, only a few thousand atoms thick, retained its superconductivity up to 23.2° K., the highest temperature yet achieved.[6]

Infrared guidance systems were being developed by the U.S. Defense Department. These systems known as FLIR (Forward Looking Infra-Red) allows aircraft, tank, and helicopter gunners to see targets at night and through smoke cover.[7]

Germanium-containing materials were developed for use as optical waveguides. The lowest transmission loss optical waveguides to date are those with a high silica content prepared by vapor deposition. The composition, a core of GeO_2-SiO_2 surrounded by SiO_2 cladding, combines low loss with relatively large index differences between core and cladding.[8]

INDIUM[9]

Domestic Production.—Domestic indium production during 1974 was by American Smelting and Refining Company (ASARCO Incorporated) at its Denver, Colo., plant and by Indium Corp. of America in Utica, New York. Other companies processed or refined imported material to produce high-purity metal components, alloys, and compounds. An appreciable portion of U.S. consumption was contributed by domestic producers, but the major share was from imported metal. A large but unmeasured share of domestic supply came from secondary or scrap materials.

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[6] Bishop, J.E. Superconductor Hunt Is Getting Warmer, Bell Labs Aides Say. Wall Street J., v. 183, No. 39, Feb. 26, 1974, p. 36.

[7] Metal Bulletin. No. 5971, Mar. 4, 1975, p. 21.

[8] MacChesney, J.B., P.B. O'Connor, and H.M. Presby. A Technique for the Preparation of Low Loss and Graded-Index Optical Fibers. The Institute of Electrical and Electronics Engineers, Inc., v. 62, No. 9, September 1974, pp. 1278-1279.

[9] Prepared by John M. Hague, mining engineer.

Uses.—The pattern of indium usage was estimated to be divided as follows: 30% in solders, low-melting alloys, and coatings; 30% in instrument applications and holding devices; 18% in electronic components; 6% in nuclear reactor controls; and 16% in research and other uses.

Stocks.—Producer stocks continued to decline, but at a reduced rate; stocks of producers and consumers are estimated to be adequate for short-term requirements.

Prices.—Indium pricing is based on the standard-grade metal, 99.97% pure. Higher purity grades, 99.999% plus, are available at a premium. Since December 1972 the producer quotation published in Metals Week has been for ingots, usually of 100 ounces, in lots of 10,000 ounces or more. The quotation remained at $2 per troy ounce through January, was $2.50 in February and March, $3 in April and May, and was raised to $5.50 per ounce by ASARCO in July, retroactive to May 13. The $5.50 quotation continued to the end of the year for an average price in 1974 of $4.42 per ounce.

Foreign Trade.—Imports of indium in 1974 decreased sharply from the 1973 level. Total imports were 493,000 troy ounces in 1974 compared to 812,000 troy ounces in 1973. Source countries ranked as follows: Canada, 36%; Peru, 21%; Japan, 18%; the United Kingdom, 12%; West Germany, 8%; the Netherlands, 4%; and East Germany, 1%.

The duty on unwrought, waste, and scrap indium has been 5% ad valorem since January 1, 1972 for the most favored nations. Since June 30, 1971, duties on waste and scrap have been suspended until June 30, 1975. The duty on wrought indium was 9%. Statutory duties for the U.S.S.R. and East Germany were 25% ad valorem on unwrought indium and 45% ad valorem on wrought metal.

Imports from the U.S.S.R. apparently did not develop in 1974 as the asking price was above the European free market. Cominco, Ltd., the sole Canadian producer, was the source of supply for over 20% of U.S. demand.

Table 8.—U.S. imports for consumption of indium in 1974, by country

Country	Quantity (troy ounces)	Value
Unwrought, waste and scrap:		
Canada	178,725	$541,801
Germany, East	3,876	9,413
Germany, West	41,073	97,152
Japan	86,939	600,112
Netherlands	19,006	57,909
Peru	102,274	328,015
Switzerland	458	4,551
United Kingdom	59,805	258,765
Total	492,156	1,897,718
Wrought: Canada	822	7,541

Technology.—Photovoltaic solar energy cells being developed by Bell Laboratories use cadmium sulfide deposited either on a substrate of single-crystal indium phosphide or on single-crystal copper indium diselenide. If these cells can be made by thin-film techniques, the cost will be less than current silicon solar cells and may allow large area cells to be made.[10]

RADIUM[11]

During 1974 radium was used mostly in therapeutic treatment of cancer. However, in medical and industrial applications, cheaper and less hazardous radioisotopes continued to replace radium. Cesium radioisotopes have replaced some quantities of radium used for cancer treatment in hospitals throughout the United States.

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[10] Chemical and Engineering News. Technology. V. 53, No. 7, Feb. 17, 1975, p. 20.

[11] Prepared by Roman V. Sondermayer, physical scientist.

Domestic Production.—There has been no production of radium in the United States since 1950. The small domestic demand was met by imports, withdrawal from dealers' stocks, and reprocessing. Radium Chemical Co., Inc., New York, was the main dealer in the country.

Consumption and Uses.—Small quantities of radium, expressed in milligrams, were used in the treatment of cancer, luminous compounds, static eliminators, and neutron sources. Nearly 5 grams of new radium were sold, and about 900 grams of radium were in use in the United States during 1974. About 90 grams were stored in a Government-owned depository in Alabama. During 1974 129 requests for deposits of 665 radioactive sources, containing about 3,758 milligrams of radium, were received by the Bureau of Radiological Health, U.S. Department of Health, Education, and Welfare.

Substitution of manmade radioisotopes for radium continued during 1974.

Prices.—Radium prices, per milligram, were quoted by Radium Chemical Co., as follows: Less than 100 milligrams, $26.50; 100 to 199 milligrams, $25; 200 to 499 milligrams, $22; over 5 grams, $20.

Foreign Trade.—Data on trade in radium were not published; in most cases, the radium data were included with those for other items in trade statistics. Belgium remained the principal source of radium imported into the United States.

World Review.—Information on radium in world markets was not readily available. The Belgian company, Union Minière S.A., was the largest radium producer and supplier in the market economies. In addition, small quantities of radium were apparently produced in Canada and the United Kingdom. Czechoslovakia, with its long tradition in uranium mining, and the U.S.S.R. probably also produced some radium. Throughout the world, uses of radium were similar to those in the United States.

Technology.—Procedures were established for sequential determination of radium in the environment and in process waste samples at 0.1 down to 0.001 of the guides specified by Federal Regulations.[12]

SCANDIUM[13]

During 1974 scandium was used mostly in research, which, however, did not disclose any major useful property that was not found in less costly and more abundant elements. In the United States one producer provided most of the scandium metal and oxide consumed during the year.

Domestic Production.—There was no scandium mine production in the United States in 1974. Research Chemicals, a division of Nucor Corp., Phoenix, Ariz., remained the only domestic producer of scandium metal and compounds. Output, measured in a few tens of pounds and derived from imported materials, was adequate to meet demand.

Consumption and Uses.—The main industrial applications of scandium were in high-intensity lamps for lighting outdoor events to be televised in color and in radioactive tracers for controlling flow of underground fluids in petroleum production. Small quantities of scandium were also consumed in magnesium alloys and in the electronics and chemical industries. Scandium was used in research which was aimed at a better understanding of its properties and behavior in different environments. Researchers studied scandium radioisotopes and investigated alloying, electrical, and chemical properties of the metal, compounds, and other products.

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[12] Percival, D.R., and D.B. Martin. Sequential Determination of Radium-226, Radium-228, Actinium-227, and Thorium Isotopes in Environmental and Process Waste Samples. Anal. Chem., v. 46, No. 12, October 1974, pp. 1742-1749.

[13] Prepared by Roman V. Sondermayer, physical scientist.

Prices.—The tabulation below shows prices for scandium metal and oxide quoted by Research Chemicals:

Metal	Per gram, from 1 to 99 grams	Per gram, from 100 to 453 grams
Ingots	$10.50	$8.00
Powder	11.50	10.35
Chips	11.50	10.35
Distilled	19.00	15.00
Oxide:		
99.99%	5.00	4.00
99.9%	3.50	2.80
Salts [1]	2.50	2.00

[1] Salts include acetates, carbonates, chlorides, nitrates, and oxalates in most stable, hydrous form produced from oxides of 99.9% minimum purity.

Foreign Trade.—Official U.S. foreign trade statistics did not report trade in scandium as such but included scandium with other minerals and metals. However, based on available information, Australia and the centrally controlled economies were the principal suppliers of scandium-bearing raw materials.

World Review.—Information on scandium-related activities in foreign countries was not readily available. The industrialized nations were involved in scandium research and used small quantities of scandium in industrial applications.

Technology.—Scandium and the rare earth metals, at concentrations of 0.01 to 0.1 weight percent in uranium matrix alloys, were quantitatively determined by atomic absorption in perchloric acid solution of the alloy without separation. According to Los Alamos Scientific Laboratory scientists, the measurement's standard deviation for scandium at 0.1 wt% and 0.01 wt% was 1% and 5%, respectively.[14]

In another research project, dioctylarsenic acid (HDOAA) in chloroform solution was investigated as a reagent for the extraction of scandium, cerium, europium, and ytterbium trichlorides. The extraction coefficients for these metal ions were sufficiently different to allow their extractive separation.[15]

SELENIUM [16]

Domestic production of selenium from primary materials was 644,000 pounds in 1974, a 19% decrease from the 1973 production of 796,000 pounds.

Shipments by domestic producers decreased 21% to 671,000 pounds. Producer stocks were drawn down by 27,000 pounds and were 79,000 pounds at yearend. The cutback in production and shipments was the result of a 42-day copper strike in Arizona in July and August and decreased demand in the second half of the year. World production remained constant at 2,621,000 pounds.

Under its program to dispose of the national stockpile of selenium, the General Services Administration (GSA) sold 124,442 pounds of selenium during the year and made shipments for consumption of 223,606 pounds. At the end of 1974 the national stockpile contained 8,639 pounds of which less than 2,500 pounds is uncommitted.

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[14] Gardner, R.D., A.L. Henicksman, and W.H. Ashley. Determination of Selected Rare Earths in Uranium Alloys by Atomic-Absorption Spectometry. Los Alamos Sci. Lab. Contract W-7405, Eng. 36, February 1974, 5 p.

[15] Igrolic, K., and A. M. Olivares. Di(N-Octyl)-Arsenic Acid (HDOAA) as a Reagent for Liquid-Liquid Extraction: Extraction of Scandium(III), Cerium(III), Europium(III), Holmium(III), and Ytterbium(III). Microchim. Acta, No. 3, 1974, pp. 369-380.

[16] Prepared by George J. Coakley, physical scientist.

Table 9.—Salient selenium statistics

(Thousand pounds of contained selenium)

	1970	1971	1972	1973	1974
United States:					
Production, primary	1,005	657	739	^{r} 796	644
Shipments to consumers	1,056	663	761	^{r} 851	671
Imports for consumption	454	395	430	558	887
Exports, metal	^{e} 376	^{e} 150	^{e} 220	^{e} 264	166
Shipments from Government stocks	--	--	14	229	224
Apparent consumption	1,134	908	985	1,369	1,566
Stocks, Dec. 31, producer	189	182	161	106	79
Producers price, average per pound, commercial and high-purity grades	\$9–\$10.50	\$9–\$11.50	\$9–\$11.50	\$9.25–\$12.36	\$16.53–\$19.19
World: Production	2,888	2,506	^{r} 2,721	^{r} 2,626	2,621

^{e} Estimate. ^{r} Revised.

Domestic Production.—In the United States in 1974 selenium was recovered at the following four copper refineries: AMAX Copper, Inc., Carteret, N.J.; American Smelting and Refining Company (ASARCO Incorporated), Baltimore, Md.; Kennecott Copper Corp., Magna, Utah; and The Anaconda Company, Perth Amboy, N.J.

In addition anode slimes recovered from the electrolytic tanks of copper refineries owned by other foreign and domestic mining companies were shipped to these plants for recovery of gold, silver, selenium, and tellurium.

High-purity selenium and various selenium compounds were produced by primary and other processors from commercial-grade metal.

Published estimates of secondary recovery of selenium from xerographic, rectifier, and chemical processes in 1974 of 185,000 pounds include both Canadian and U.S. reclamation.[17] However a large portion of the Canadian secondary production is accounted for by imports of selenium scrap from U.S. markets. Data on actual recovery by domestic secondary refineries were not available but recovery was estimated to have ranged from 30,000 pounds of selenium in 1970 to less than 20,000 pounds in 1974.

ASARCO's new 420,000-ton-per-year electrolytic copper refinery at Amarillo, Tex., was 55% complete at yearend. Completion of the entire facility including a byproduct plant is planned for the first quarter of 1976. The ASARCO Baltimore refinery will be phased out at that time. Anaconda is reportedly considering closing its Perth Amboy copper and byproduct refinery in 1975.

Consumption and Uses.—Apparent consumption of selenium in 1974 consisting of shipments from primary producers, net imports, and stockpile releases was over 1.5 million pounds, an increase of 14% over that in 1973. Demand for selenium began decreasing in the second half of 1974 as the requirements for selenium-bearing glass, pigments, and electronic components were affected by the sharp slowdown in manufacturing and construction activity. Trends in 1974 suggested the following estimate of selenium purchases and consumption by end use categories: Electronic components including xerography, 45%; glass manufacturing, 34%; chemicals, 13%; and other, 8%.

Xerography continues to be a major growth industry for selenium with an estimated 350,000 to 400,000 pounds consumed in 1974. Proposed settlement of an antitrust action by the Federal Trade Commission would require Xerox Corp. to provide know-how and patents to licensees.[18]

In other electronic applications the high demand for selenium in semiconductors used in calculators, photoelectric cells, and in the vidicon television camera continued. Shipments of all types of semiconductors increased about 16% in the United States in 1974 over those of 1973, however, an industrywide slump had begun in the second half of 1974.[19] With lower cost silicon substitutes on the market the production of selenium rectifiers was beginning to decline with a resulting decrease in rectifier scrap available for secondary recycling.

The largest single consumer of selenium

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[17] Baltrusaitis, V.A. Selenium-Tight Supplies Ease Up at End of '74. Eng. and Min. J., v. 176, No. 3, March 1975, pp. 153-155.

[18] The Wall Street Journal. IBM Attacks FTC Proposed Settlement of Antitrust Complaint Against Xerox. V. 185, No. 2, Jan. 3, 1975, p. 18.

[19] The Wall Street Journal. After Bad 2nd Half, Semiconductor Firms See More of Same for Much of This Year. V. 185, No. 2, Jan. 9, 1975, p. 26.

continued to be the glass manufacturing industry, although selenium is somewhat vulnerable to substitution by the rare earth, cerium oxide. Selenium is added in amounts of 0.02 to 0.3 pound per ton of glass to neutralize the green iron discoloration. Dark-colored selenium glass used in office windows to reduce glare and heat transfer is finding a growing energy conservation application.

In its major use in the industrial chemical field cadmium sulfoselenate compounds are used widely as heat-resistant red pigments in plastics, paints, inks, and enamels. The expansion of new pharmaceutical preparations saw consumption in this area increase to about 50,000 pounds of selenium in 1974.

Demand for selenium in other end uses included the addition of small amounts of ferroselenium to improve the casting, forging, and machining characteristics of stainless steel. There are also minor applications for elemental selenium and selenium diethyldithiocarbamate in the processing of natural and synthetic rubber. In February 1974 the Federal Food, Drug, and Cosmetic Act was amended to allow the maximum addition of 0.1 part per million of sodium selenite to premixed chicken and swine feeds and 0.2 part per million to premixed turkey grain feeds as a nutrient to control diseases and to increase production.[20] As the practice becomes widespread, it is estimated that annual consumption will be 13,000 pounds.

Stocks.—GSA essentially completed its disposal of the national stockpile of selenium during 1974. The combination of a record high consumption and the copper industry strike reduced producer stocks to the equivalent of 2 weeks' domestic demand in the second quarter. Reduced demand in the fourth quarter allowed producers to start rebuilding inventories which totaled 79,000 pounds on December 31, 1974. The high apparent consumption in 1974 is attributed in part to manufacturers buying ahead to cover future requirements. Japan, the world's largest producer of selenium, built up large stocks of unsold selenium during the second half of 1974. The overhang of excess Japanese stocks on the world market contributed to weakened price levels.[21]

Prices.—Selenium is usually sold as commercial-grade powder containing 97% to 99.94% selenium or as high-purity grade in pellets, sticks, and rectifier shot containing 99.95% to 99.99+% selenium. Pellets containing 99.999+% selenium are available. Domestic producer prices for commercial and high-purity grades increased from $11 and $14 per pound, respectively, in January 1974 to $15 and $18 per pound in March. A further increase in May raised prices to $18 and $21 per pound. Merchant prices for commercial-grade selenium increased from $17.50 per pound in January to a high of $37.50 in June, but by the end of the year prices had slipped to $11 to $13 per pound.

Merchant prices generally responded to high and low demand pressures during the year. The producers price however, showed a steady upward trend.

Foreign Trade.—The U.S. Department of Commerce reported selenium exports separately for the first time in 1974.[22] Exports of selenium metal in 1974 totaled 166,206 pounds, valued at $2,013,322, with an average value of $12.11 per pound. Shipments to West Germany (30%), the Netherlands (16%), Belgium (13%), the United Kingdom (12%), Australia (6%), Canada (4%), and France (4%) accounted for the majority of all exports with the remainder exported in lots of 6,000 pounds or less to 13 other countries.

Table 10.—U.S. exports of selenium in 1974, by country

(Thousand pounds and thousand dollars)

Country	Quantity	Value
Argentina	3	24
Australia	10	92
Belgium	22	334
Brazil	(1)	1
Canada	7	114
China, People's Republic of	(1)	1
France	7	77
Germany, West	50	510
Indonesia	1	8
Italy	6	56
Japan	1	4
Korea, Republic of	1	9
Malaysia	1	24
Mexico	4	39
Netherlands	27	386
New Zealand	(1)	6
South Africa, Republic of	5	76
Spain	1	13
Switzerland	(1)	1
United Kingdom	20	238
Total	166	2,013

[1] Less than ½ unit.

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[20] U.S. Food and Drug Administration. Selenium in Animal Feed. Federal Register, v. 39, No. 5, Jan. 8, 1974, pp. 1355-1358.

[21] Metals Week. V. 45, No. 48, Dec. 2, 1974, p. 7.

[22] U.S. Department of Commerce. Foreign Trade Statistics. Classification of Exports. Sec. 5. Chemicals. Schedule B, Selenium Metal, code 513.290, 1974.

Selenium imports for consumption increased 51% to 837,191 pounds and the value of imports increased 88% over that of 1973 to $10,555,973. The average value of unwrought, waste and scrap selenium imported during the year was $12.74 per pound and for selenium dioxide $10.42 per pound. Canada supplied 87% of all selenium imported, with the remainder coming from Japan (5%), Belgium (3%), Norway (2%), and nine other countries (3%). In addition to the above, 712 pounds of selenium salts valued at $18,105 and 3,356 pounds of unspecified other selenium compounds valued at $36,827 were imported into the United States in 1974.

U.S. tariff schedule items 632.40, selenium metal, unwrought, other than alloys and waste and scrap; 420.50, selenium dioxide; and 420.52, selenium salts; were duty free at yearend. The duty on item No. 420.54, other selenium compounds, was 5% ad valorem.

Table 11.—U.S. imports for consumption of selenium in 1974, by country

(Thousand pounds and thousand dollars)

Country	Quantity	Value
Unwrought, waste and scrap:		
Belgium-Luxembourg	23	399
Canada	685	8,030
Germany, West	5	103
Ireland	(1)	8
Japan	42	872
Mexico	5	96
Netherlands	3	59
Norway	16	213
Peru	2	53
Sweden	(1)	1
Switzerland	2	57
Yugoslavia	7	171
Total	790	10,062
Oxide (selenium content):		
Canada	40	375
Germany, West	4	80
Spain	3	39
Total	47	494

[1] Less than ½ unit.

World Review.—In 1973 the United States continued as the leading selenium producer, followed by Japan. In 1974 Japan was the leading producer with an output of 800,000 pounds. In both years Canada was the third largest producer. These three countries accounted for 81% of world selenium production in 1973 and 78% in 1974.

Canada.—Selenium production from primary raw materials has decreased since 1971 as an increasing amount of copper production from Canadian mines is derived from selenium-poor ores. The major selenium producers, Canadian Copper Refiners Ltd. and The International Nickel Co. of Canada, Ltd. with annual capacities of 500,000 pounds and 180,000 pounds of selenium, respectively, were unable to meet demand from primary production in 1973 and 1974. In 1973 exports to all countries exceeded primary production by 242,000 pounds and in 1974 by 337,000 pounds. In 1973 Canada consumed only 22,000 pounds of selenium domestically.

Japan.—Japan continued to import large tonnages of copper concentrates under long-term contract arrangements with producers in Australia, Canada, and Latin America which ensured it of large supplies of raw selenium-bearing materials. During periods of depressed market conditions such as occurred in both copper and selenium in late 1974 the Japanese continued to refine the copper and associated slimes in order to keep on top of the fixed volume of raw materials flowing into the country.

Table 12.—Selenium: World refinery production, by country[1]
(Thousand pounds)

Country	1972	1973	1974 [p]
Australia	81	[r] [e] 90	[e] 95
Belgium-Luxembourg [2]	[r] 135	65	123
Canada	[3] 720	[3] 581	[4] 591
Finland	11	20	[e] 22
Japan	738	756	800
Mexico	97	86	110
Peru	18	17	[3] 17
Sweden	92	[e] 120	[3] 120
United States	739	796	644
Yugoslavia	90	95	99
Total	[r] 2,721	2,626	2,621

[e] Estimate. [p] Preliminary. [r] Revised.

[1] Insofar as possible data relate to refinery output only; thus countries that produce selenium contained in copper ores, copper concentrates, blister copper and/or refinery residues, but do not recover refined selenium are excluded to avoid double counting.

[2] Net exports (exports minus imports).

[3] Refinery output from all sources, including imports and secondary sources.

[4] Recoverable selenium content of the blister copper treated at domestic refineries, plus refined selenium from domestic primary material.

Technology.—A U.S. patent was issued on a solvent extraction process used to recover selenium from an aqueous, offgas scrubber solution from the roasting of molybdenite. The process uses a tertiary amine to extract metal values. Molybdenum and rhenium values are stripped with aqueous sodium carbonate and then selenium values with an aqueous solution of ammonium hydroxide or sodium sulfite.[23]

As an offshoot of research to develop an organic material that would be a superconductor at or above room temperature, a new crystal has been designed by replacing sulfur atoms with selenium atoms in a solid organic crystal. The new crystal conductor is one of the most electrically conductive organic metals so far reported and retains this behavior at lower temperatures (40°K) than any other material.[24]

Baltrusaitis,[25] also noted that a European battery manufacturer has developed a lead-selenium alloy which helps to eliminate gas discharge and reduces antimony requirements. In this application, selenium is being tested in competition with calcium for performance in maintenance-free batteries.

A comprehensive reference book on selenium was published in late 1974 covering the history, occurrence, extraction, properties, biochemical and agricultural aspects, toxicology, analytical chemistry, and five chapters on end use applications.[26]

TELLURIUM[27]

Domestic tellurium production of 191,000 pounds in 1974 was 21% below that of 1973. The primary producers shipped 157,000 pounds of tellurium to consumers in 1974, a decrease of 45% from 1973. Producer stocks increased 55% to 87,000 pounds. The level of imports increased 131% to a record high of 164,000 pounds in 1974.

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[23] Carey, C.D., and R.N. Platzke. Solvent Extraction Recovery of Selenium from Molybdenite. U.S. Pat. 3,848,069, Nov. 12, 1974, 4 pp.

[24] Chemical and Engineering News. IBM Develops Solid Organic Conductors. V. 52, No. 39, Sept. 30, 1974, pp. 18-19.

[25] Work cited in footnote 17.

[26] Zingaro, R.A., and W.C. Cooper (ed.). Selenium. Van Nostrand Reinhold Co., New York, 1974, 835 pp.

[27] Prepared by George J. Coakley, physical scientist.

Table 13.—Salient tellurium statistics
(Thousand pounds of contained tellurium)

	1970	1971	1972	1973	1974
United States:					
Production	158	164	257	241	191
Shipments to consumers	209	163	271	287	157
Imports for consumption	64	30	146	71	164
Apparent consumption	273	193	417	358	321
Stocks, Dec. 31, producer	128	116	102	56	87
Producers price: Average per pound, commercial grade	$6	$6	$6	$6.05	$8.34
World: Production	367	320	r 396	r 446	362

r Revised.

Domestic Production.—Tellurium was recovered as a byproduct of electrolytic copper refining by: AMAX Copper, Inc., Carteret, N.J.; American Smelting and Refining Company (ASARCO Incorporated), Baltimore, Md.; and The Anaconda Company, Perth Amboy, N.J. Commercial grade tellurium was produced from the precious-metal-rich anode slimes shipped from other domestic copper refinery tankhouses. High-purity tellurium, tellurium master alloys, and tellurium compounds were produced by primary and intermediate processors from commercial-grade metal and tellurium dioxide. Lower production of tellurium in 1974 was attributed to a combination of the copper industry strike in July and August and lower tellurium content of ores being mined. Construction of ASARCO's new copper and copper byproducts refinery in Amarillo, Tex., was on schedule and startup is expected in early 1976 at which time the Baltimore facility will be phased out. Anaconda was reportedly considering closing its Perth Amboy refinery in 1975.

Consumption and Uses.—Apparent consumption of tellurium for the year as indicated by producer shipments to consumers and imports for consumption decreased 10% to 321,000 pounds from 1973. The decrease can be related to the general slowdown of the U.S. economy, particularly in the second half of the year. Manufacturers were working off inventories and there was less consumer buying of the iron, steel, and copper products which consumed most of the tellurium. Tellurium consumption by end use in 1974 was estimated as follows: Iron and steel production, 70%; nonferrous metal production, 19%; chemical uses, 6%; and other uses including rubber manufacturing, 5%. Tellurium is used in its elemental state as a free-machining agent in stainless steel and copper production, in the chilling of malleable cast iron, and as a curing agent and accelerator in rubber compounding. Bismuth and lead telluride alloys are used in semiconductor and minor thermoelectric applications. Tellurium is used in the dioxide state in the forming and tinting of glass and as a chemical catalyst. Applications for tellurium are somewhat limited by the relatively small availability of refined material and by price. These factors make tellurium susceptible to substitution, particularly by lead which exhibits many of the same machining properties as tellurium. Selenium and sulfur can substitute for tellurium in rubber compounding and selenium also substitutes in some semiconductor applications.

Stocks.—Producers began to rebuild stocks in 1974 adding 31,000 pounds to the abnormally low 1973 stocks of 56,000 pounds. In addition to inventories of refined tellurium there are available stockpiles of crude materials and impure intermediate tellurium products which are accumulated for refining as needed. There is no tellurium in the U.S. Government stockpile.

Prices.—The producer price for commercial-grade powder and slab was $7 per pound until May 1 when the price was increased to $9 per pound which remained firm for the remainder of the year. Noranda Mines Limited raised the Canadian producer price to $10 per pound on November 29, 1974, however, the U.S. producers did not follow this change. Prices for high-purity tellurium ranged from $10 to $32 per pound depending upon quality and quantity.

Tellurium is usually marketed in the form of minus 200-mesh powder or as slabs, tablets, or sticks. Normal commercial grades contain a minimum of 99% or 99.5% tellurium. Further refining through distillation and sublimation processes produces high-purity grades chiefly for use in semiconductors containing 99.95%, 99.999%, and 99.9999% tellurium.

Foreign Trade.—Imports of tellurium for consumption in the United States in 1974 were the highest on record, totaling 164,000 pounds, 131% higher than in 1973 and 73% higher than the average imports during 1970–74. Canada supplied 72% and Peru 22% of all imports.

The 1974 U.S. tariff on TSUS Item No. 632.48, tellurium metal, unwrought, other than alloys, and waste and scrap was 4% ad valorem and TSUS Items No. 421.90, tellurium compounds and 427.12, tellurium salts was 5% ad valorem. The statutory tariff on these items was 25% ad valorem. There are no data on tellurium exports.

Table 14.—U.S. imports for consumption of tellurium in 1974, by country

(Thousand pounds and thousand dollars)

Country	Quantity	Value
Unwrought, waste and scrap:		
Canada	118	1,224
Germany, West	(1)	1
Japan	6	41
Peru	36	289
United Kingdom	4	26
Total	164	1,581

[1] Less than ½ unit.

World Review.—The United States continued as the world's largest producer and consumer of tellurium. In 1974 the United States produced 53% of all new refined tellurium while the U.S. apparent consumption was 90% of total world production of 362,000 pounds. The balance of world tellurium output in 1974 was nearly equally distributed among Peru, Japan, and Canada.

Fiji.—The Emperor Gold mine at Vata Koula, Fiji, was scheduled to increase annual tellurium production to 40,000 pounds, but no detailed production figures are yet available. This would make the Emperor Gold mine the world's largest tellurim producer.[28] Emperor has reportedly developed a new telluride leaching process which improves the economic feasibility of extracting tellurium from gold telluride resources, and which could encourage the further production of tellurium from similar deposits in Colorado and elsewhere in the world.

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[28] Cajka, C.J. Selenium and Tellurium. Canadian Minerals Yearbook, Preprint No. 41, 1973, November 1974, 7 pp.

Table 15.—Tellurium: World refinery production by country[1]

(Thousand pounds)

Country[2]	1972	1973	1974 p
Canada	r 3 58	3 93	4 54
Japan	77	54	57
Peru	4	58	e 60
United States	257	241	191
Total	r 396	446	362

e Estimate. p Preliminary. r Revised.

[1] Insofar as possible data relate to refinery output only; thus countries that produce tellurium contained in copper ores, copper concentrates, blister copper and/or refinery residues, but do not recover refined tellurium are excluded to avoid double counting.

[2] In addition to the countries listed, Australia, Belgium, West Germany, and the U.S.S.R. are known to produce refined tellurium, and other major copper refining nations such as Chile, Zaire, and Zambia may produce refined tellurium but production is not reported and available information is inadequate for formulation of output level estimates.

[3] Refinery output from all sources, including imports and secondary sources.

[4] Recoverable tellurium content of blister copper, not necessarily recovered in year designated, plus refined tellurium from domestic primary metal.

Technology.—Copper metallurgy is likely to be modified or changed to minimize smelter air pollution, but it is uncertain what the effect will be on tellurium and selenium recovery. A change to low-pollution furnaces that capture a much greater proportion of effluents would increase the quantity of byproduct tellurium available, while a change to in situ leaching and other hydrometallurgical methods for treating copper ores and concentrates would reduce the recovery of tellurium.

THALLIUM [29]

Thallium is a highly toxic metal that is limited in production, use, and size of market.

Domestic Production.—The only domestic producer of thallium and thallium compounds was the Globe plant of the American Smelting and Refining Company (ASARCO Incorporated) of Denver, Colo. The company recovered thallium as a byproduct from flue dusts and residues of base metal ore smelting, principally zinc. Production of metal and compounds in 1974 was about 1% of that of 1973. Shipments remained about the same.

World Reserves.—Domestic and world reserves of thallium in lead, zinc, and iron sulfide ores were 266 and 1,390 tons, respectively. World resources of thallium, not economically extractable or undiscovered, in zinc and lead sulfides were estimated at 21,672 tons.[30]

Uses.—The United States consumes a very small fraction of total world production. Formerly, the principal use of thallium was a rodenticide. Since 1972 thallium has been banned by Federal edict for all domestic pesticide use. The current uses for thallium are for certain specialized electronic components, pharmaceuticals, agriculture, and for experimental purposes.

Prices.—The price of thallium in 25-pound lots has been $7.50 per pound since December 1957.

Foreign Trade.—U.S. imports for consumption in 1974 were 1,022 pounds of unwrought, and waste and scrap thallium valued at $4,644 and 404 pounds of compounds valued at $4,308. The amount was almost twice that imported in 1973 which totaled 541 pounds valued at $1,730.

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Table 16.—U.S. imports for consumption of thallium in 1974, by country

Country of origin	Compounds (gross weight)		Unwrought, and waste and scrap	
	Pounds	Value	Pounds	Value
Belgium-Luxembourg	50	$813	25	$370
Canada	--	--	4	778
Germany, West	253	3,042	--	--
Netherlands	101	453	--	--
U.S.S.R	--	--	993	3,496
Total	404	4,308	1,022	4,644

World Review.—World production of thallium is approximately 30,000 pounds annually. In addition to the United States, other major producers of thallium metal and compounds were Belgium, West Germany, and the U.S.S.R.

Technology.—Experiments with high-pressure mercury vapor lamps containing thallium iodide continued. One worker produced a mercury vapor light with a wider spectrum than fluorescent light and a 50% improvement in light intensity over conventional mercury lamps.[31] A new film emulsion containing thallium lead, or gold azides capable of performing under extremely cold conditions prevalent in space was developed for the U.S. Army.[32]

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[29] Prepared by Ronald J. DeFilippo, physical scientist.

[30] Robinson, K. Thallium. Ch. in United States Mineral Resources. U.S. Geol. Survey Prof. Paper 820. 1973, pp. 631-636.

[31] Poppe, K. Light Measurement on Discharge Lamps with Metal Halide Ingredient. Meres. Automat. (Hungary), v. 21, No. 9, 1973, pp. 359-362.

[32] Wiegand, D.A. (Assigned to the U.S. Department of the Army). Inorganic Azides as Photosensitive Material at Low Temperatures. U.S. Pat. 3,778,269, Dec. 11, 1973.

Use of thallium to change the refractive index of glasses continued to be an area of experimentation.[33]

The first known occurrence in gold ore of lorandite, $TlAsS_2$ was discovered in Nevada. The mineral, which contains an average of 60% thallium, was apparently part of the late-stage mineralization of the gold ore.[34]

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[33] Blair, H.D., and M.E. Milburg. Defect Structure of Thallium Silicate Glass. Am. Ceram. Soc. J., v. 57, No. 6, June 1974, pp. 257-260.

[34] Radke, A.S., C.M. Taylor, R.C. Erd, and F.W. Dickson. Occurrence of Lorandite, $TlAsS_2$, at the Carlin Gold Deposit, Nevada. Econ. Geol., v. 69, No. 1, January 1974, pp. 121-123.

Minor Nonmetals

By Staff, Division of Nonmetallic Minerals

CONTENTS

	Page		Page
Greensand	1435	Quartz Crystal	1446
Iodine	1435	Staurolite	1448
Lithium	1438	Strontium	1448
Meerschaum	1446	Wollastonite	1451

GREENSAND[1]

The only U.S. producer of greensand (glauconite) in 1974 was the Inversand Co. at Clayton, N.J., which is a subsidiary of Hungerford & Terry, Inc. Information on production and sales is withheld by the Bureau of Mines to avoid disclosing individual company data.

Greensand was used by the parent company in its line of water conditioning equipment. The finer fraction of the material produced, which is unsuitable for water conditioning, was screened out, dried, and sold as a soil conditioner.

The Delaware Geological Survey, in cooperation with the Federal Bureau of Mines, continued its investigation of possible uses for greensand. It was found that the material tested has the capacity to lower the content of many heavy metal contaminants in industrial waste waters. Concentrations of arsenic, cadmium, chromium, copper, lead, silver, and zinc were greatly decreased; it was found that these metals can be easily released back into distilled water, suggesting that the cations are adsorbed on the surface of glauconite pellets, rather than exchanged within the glauconite crystal structure.[2]

IODINE[3]

The world iodine picture changed drastically during 1974. At the beginning of the year, the market was still sluggish and stocks were fairly high. By yearend, demand was up sharply and a long-term shortage was forecast. Prices moved upward from between $2.06 and $2.27 per pound of iodine to $2.40 and $2.59. The Japanese were considering raising prices further to $2.90. U.S. imports during the first 9 months of 1974 were as much as the full-year imports in 1972 and 1973. As in the past, imports from Japan and, secondarily, Chile far exceeded domestic production. The sole U.S. producer—The Dow Chemical Co.—had the longest strike in its history, but output remained at the 1973 level. Late in the year, a joint venture of Pittsburgh Plate Glass Co. (PPG) and Amoco Oil Co. announced plans to develop high-grade iodine brines at Woodward, Okla., for production by yearend 1976. Ethyl Corp. also announced the discovery of similar brines nearby and may be seriously considering future exploitation.

Japan continued to dominate the world scene despite ground subsidence and relocation problems. Production in 1974 was down 9% from the more than 16 million pounds produced in 1973. An upswing was not expected until 1976 or later, which explains why increasing world shortages might be in the offing during the next 2 years. The Chilean iodine situation became more stable with the improved internal situation, and resumption of shipments to the United States to previous high levels might be expected.

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[1] Prepared by William F. Keyes, physical scientist.

[2] Spoljaric, N., and W. A. Crawford. Removal of Metallic Contaminants From Industrial Waste Waters by the Use of Greensands: A Preliminary Report. Del. Geol. Survey Open File Rept., January 1975, 12 pp.

[3] Prepared by K. P. Wang, supervisory physical scientist.

Legislation and Government Programs.—On December 31, 1974, the Government strategic stockpile contained 8,011,814 pounds, exactly the same quantity as a year earlier. The stockpile objective for iodine was reduced to zero in early 1973. However, without congressional approval, no iodine withdrawals were possible.

Domestic Production.—Dow Chemical continued to recover crude iodine from well brines at Midland, Mich., as a coproduct with bromine, calcium and magnesium compounds, and potash. A nearly 6-month strike ended in early September. Production did not suffer because "salaried" workers manned the operations.

Table 1.—Crude iodine consumed in the United States

Products	1973			1974		
	Number of plants	Crude iodine consumed		Number of plants	Crude iodine consumed	
		Thousand pounds	Percent of total		Thousand pounds	Percent of total
Resublimed iodine	6	689	12	6	544	9
Potassium iodide	10	1,568	27	32	1,918	32
Other inorganic compounds	17	1,059	r 19	21	1,096	18
Organic compounds	19	r 2,439	r 42	23	2,517	41
Total	[1] 32	r 5,755	100	[1] 33	6,075	100

r Revised.

[1] Nonadditive total because some plants produce more than one product.

Consumption and Uses.—Based upon a Bureau of Mines canvass, approximately 6.1 million pounds of crude iodine was consumed by 33 firms in 14 States. Leading iodine-consuming States in 1974, in descending order of magnitude, were Missouri, New Jersey, New York, and Pennsylvania, which together accounted for three-fourths of the total crude iodine consumption.

The canvassed information is indicative of the consumption pattern but is not necessarily all inclusive. Iodine and iodides used as catalysts and in "dissipative" uses in general, particularly in making synthetic rubber, are not well covered. Imports alone have been consistently higher than reported consumption, with net differences as follows, in thousand pounds: 1970–981; 1971–2,473; 1972–949; 1973–348; and 1974–1,895. Real consumption of iodine in the United States may have been closer to 7 million pounds in 1974.

Iodine consumed in making immediate downstream products, such as resublimed iodine, potassium iodide, sodium iodide, and organic iodine-containing compounds have increased slightly in recent years for most items. As for ultimate downstream uses, the major categories for 1974 were roughly as follows: Catalysts (that is, in rubber) 20%; food supplements (animal and fowl feed, mainly for cattle), 15%; stabilizers (that is, in nylon), 15%; inks and colorants, 15%; pharmaceuticals, 15%; and sanitary uses, 10%. Iodine was also consumed in making high-purity metals, motor fuels, iodized salt, photographic chemicals, smog inhibitors, and lubricants.

Prices.—Japan and Chile both raised iodine prices from $2.27 a pound to $2.59 in September. Japan did so primarily because of increases in energy costs, and Chile followed suit. Also, world demand exceeded supply late in the year. Dow Chemical held its iodine price at $2.40 per pound. Quoted U.S. prices for iodine and iodine compounds at yearend 1974 were as follows:

	Per pound
Crude iodine, drums	$2.40–$2.59
Resublimed iodine, U.S.P., drums, f.o.b. works	4.00– 5.10
Calcium iodate, drums, delivered	2.50– 2.80
Calcium iodide, 35-pound drums, f.o.b. works	5.98
Potassium iodide, U.S.P., crystals, drums, 1,000-pound lots, delivered	3.45– 3.98
Sodium iodide, U.S.P., crystals, 300-pound drums, freight equalized	3.50– 3.91

Source: Chemical Marketing Reporter.

Foreign Trade.—Crude iodine imported into the United States in 1974 rose 30% in quantity compared with that of 1973, and total value increased 40%. The average value of imported crude iodine rose from $1.72 per pound in 1973 to $1.86 in 1974. About 7.97 million pounds of crude iodine was imported, 81% from Japan and 19% from Chile. In a shortage situation, Chilean iodine was much more easily sold in the U.S. market than a year earlier. Imports of resublimed iodine were nominal as compared with imports of crude iodine.

Tariff rates were 8 cents per pound on resublimed iodine and 12 cents per pound on potassium iodide; crude iodine enters the United States duty free.

Table 2.—U.S. imports for consumption of crude iodine, by country
(Thousand pounds and thousand dollars)

Country	1972		1973		1974	
	Quantity	Value	Quantity	Value	Quantity	Value
Chile	--	--	88	160	1,505	2,972
Japan	6,207	10,184	r 6,061	r 10,425	6,465	11,877
Total	6,207	10,184	r 6,149	r 10,585	7,970	14,849

r Revised.

World Review.—*Chile.*—Production of crude iodine in 1974 as a byproduct of nitrates probably exceeded 2,500 tons, compared with a reported 2,435 tons in 1973. These tonnages reflect the combined capacities of existing facilities. Under Chile's new Government, sales were being pushed, and a program to increase production of nitrates and iodine has been initiated. Shortage of capital funds, however, may delay completion of expansion projects that have been designed to increase capacities by possibly one-fourth.

Chile's three iodine plants (and corresponding three nitrate mines)—Pedro de Valdivia, Maria Elena, and Victoria—were all owned by Sociedad Química y Minera de Chile, S.A. (SOQUIMICH). During 1974, the nitrate capacity for Valdivia, Elena, and Victoria was approximately 500,000 tons, 300,000 tons, and 150,000 tons, respectively. Thus, Valdivia's iodine production probably was slightly larger than the other two combined. Valdivia remained unable to produce as much iodine as it could prior to a major fire in late 1971.

Chile regained some of its previously lost market in the United States, partly because of the strong demand. Its pricing policy in 1974 was to follow Japanese quotations. During the first half of 1974, Chile shipped about 250 tons of iodine to the United States and 1,450 tons elsewhere.

China, People's Republic of.—China's iodine output remained small, probably coming from operations in Amoy (Fukien Province), Peihai (Kwangsi Chang Province), and Yuncheng (southern part of Shansi Province). Sizable imports were necessary. Shipments from Chile to China probably have been about 660,000 pounds of iodine annually. During 1974, Japan exported 22,000 pounds of iodine to China, compared with 64,000 pounds in 1973.

Indonesia.—Japanese firms have made serious efforts to develop iodine-bearing brackish waters in Indonesia. Ise Chemical Industries, Ltd.'s joint venture with Mitsui & Co. Ltd. and the Indonesian Government had a tentative target to produce possibly 1 million pounds of iodine annually in a few years' time.

Japan.—Japan continued to be the world's leading iodine producer by far during 1974. Its output of about 7,327 tons of crude iodine, a 9% decline from the 8,038 tons produced in 1973, was still nearly three times that of Chile, the world's second largest producer. The bulk of the Japanese production was exported, approximately half to the United States, which took 3,233 tons in 1974. Japan's other important iodine markets included European Community countries, India, Switzerland, the U.S.S.R., and Canada.

Natural gas brines are the source of Japan's iodine. Eighteen plants owned by five manufacturing groups provided the entire output. All iodine plants, except for one in Niigata, are located around Kuhikurihama on Chiba Peninsula. About two-thirds of the plants are fairly old. Ise Chemical, with half of the country's iodine capacity and most of the better plants (seven in all), continued to operate near optimum capacity. Six other firms, headed by United Resources Co., produced iodine. Half of the plants of these latter companies were having ground subsidence difficulties related to withdrawal of brines and failure to pump adequate solutions back.

In 1973–74, Japan's environmental agency, the Ministry of International Trade and Industry, and Chiba Prefectural authorities started to implement various measures to control ground subsidence, such as discouraging construction of new wells, abandonment of inefficient operations, mandatory recycling of water, and planned discharge of waste solutions. The immediate consequence of these measures was reduced iodine output. At yearend 1974, it became apparent that more than a 10% drop in production might be expected in the coming year. To adjust to these circumstances, all Japanese iodine producers were searching for new raw material sources in places like Niigata, Okinawa, Miyazaki, and Indonesia, even though the grade of brines in these areas may not measure up to the 80- to 100-parts-per-million quality brines of Chiba.

Japan has traditionally set the price of iodine at levels that the traffic can bear without turning to substitutes. However, several significant developments in 1973–74 have cut down on profitability for Japanese iodine producers. Weakening of the Japanese yen meant higher prices in terms of U.S. dollars. Labor costs rose sharply for iodine operations in 1974, and energy costs more than doubled. This explains why the Japanese were thinking of raising prices further with the expectation that the iodine shortage situation would persist.

U.S.S.R.—Soviet iodine production, derived from operations in the Neftechlinski, Black Sea, and Baku areas, probably was in the range from 3 to 4 million pounds in 1974. Supplementary imports were necessary. During 1974, Japan iodine exports to the U.S.S.R. were about 198,000 pounds, compared with 330,000 pounds in all of 1973.

LITHIUM [4]

Domestic output of lithium minerals and lithium carbonate, combined, increased 3% over that of 1973. Estimated total value of domestic lithium production, in the form of lithium carbonate and mineral concentrate, was approximately $35 million. Estimated world supply was 8,000 tons as contained lithium. The United States continued to produce and consume over one-half of the world's lithium supply. The Soviet Union continued as the only other significant producer of lithium compounds from indigenous minerals. Receipts of U.S.S.R.-produced lithium chemicals by selected market economy countries decreased 30% to 452 tons of contained lithium. No new major producers emerged in the world.

Total recorded imports of lithium mineral concentrate by the United States and countries of the European Economic Community decreased 24% to 26,756 short tons, with an estimated lithium content of approximately 500 tons. U.S. imports of lithium minerals decreased by nearly one-half of 3,165 tons. It was stated that any ending of United Nations sanctions on Rhodesian exports of lithium minerals would significantly improve the world supply and affect the world market.

Japan and Western European countries, including West Germany, the United Kingdom, France, and others continued to produce lithium chemicals from lithium minerals, and from lithium carbonate and hydroxide imported primarily from the

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[4] Prepared by H. B. Wood, geologist, and R. H. Singleton, physical scientist.

United States and the U.S.S.R. Japanese imports of lithium chemicals increased 9% to 686 short tons lithium content. West German imports of lithium chemicals decreased 28% to 476 short tons lithium content. Reported West German exports of lithium chemicals decreased 31% to 238 tons of contained lithium. U.S. exports of lithium chemicals were not completely reported, but apparent exports (recorded imports from the United States by trading partner countries) increased 5% to 810 tons lithium content.

Construction began at Kings Mountain, N.C., of a new 6,000-ton-lithium-carbonate plant which was scheduled for completion in late 1976. In Canada, it was announced that construction of a 5,000-ton-lithium-carbonate plant near Bernic Lake would be completed by early 1977. The combined output of these two plants would increase the world supply of lithium by approximately one-third.

Legislation ad Government Programs.—The General Services Administration (GSA) sold 2,622 short tons of lithium hydroxide monohydrate during 1974. At yearend, 2,918 tons of lithium hydroxide monohydrate were held by GSA under the Federal Property Act.

Domestic Production.—The two major lithium producers, Foote Mineral Co. (Foote) at its Kings Mountain mine and Lithium Corp. of America (Lithcoa) at its Hollman-Bean mine continued to mine and beneficiate spodumene from pegmatite dikes in North Carolina. Reserves were reported to be sufficient for at least 50 years at the current rate of production. Foote continued to recover lithium carbonate from subsurface brines at Silver Peak, Nev., where it increased its capacity to about 7,500 tons per year. Lithcoa was wholly owned by Gulf Resources & Chemical Corp., and 35% of Foote was owned by Newmont Mining Corp. Kerr-McGee Corp. produced a small quantity of lithium carbonate as a byproduct from processing Searles Lake brines for trona near Trona, Calif.

Foote began construction of a 6,000-ton-per-year lithium carbonate plant at Kings Mountain, N.C. It was anticipated that production at this facility, utilizing the sulfate process for winning lithium carbonate from spodumene, would begin late in 1976.

Lithcoa continued to lead the world in production of lithium chemicals and metal. Output totaled 13,000 tons lithium carbonate equivalent (2,400 tons lithium content) of chemicals and some lithium metal at its Bessemer City, N.C. plant. The plant processed all of the spodumene produced at their mine and also spodumene concentrate purchased from Foote's Kings Mountain mine, as well as lithium hydroxide from the GSA stockpile. Lithium chemicals were also manufactured by Foote from North Carolina spodumene and GSA-stockpile lithium hydroxide at Frazer, Pa., Sunbright, Va., and New Johnsonville, Tenn.

Consumption and Uses.—Apparent consumption in the United States continued to increase; consumption was 18% higher in 1974 than in 1973. The major chemical, lithium carbonate, was used primarily as an additive to molten electrolyte in aluminum reduction cells, mainly in the United States, to increase electrical efficiency and reduce fluoride emissions. Although domestic use in this new application doubled during the past 3 years, only about one-third of domestic aluminum potlines used lithium. Other uses for lithium carbonate included porcelain enamels, glasses, glazes, glass ceramics, and pharmaceuticals. The Federal Drug Administration approved the use of lithium carbonate as a prophylaxis for the depressive state of manic-depressive illness.

Lithium hydroxide remained the second most important chemical product. Its main use, production of multipurpose heavy-duty greases, increased moderately. About one-half of domestic greases utilized lithium stearate as a thickener. Use of lithium hydroxide as an additive to electrolyte in alkaline primary batteries continued. Use of lithium bromide and chloride for domestic adsorption airconditioning remained essentially static. Lithium chloride, used to make lithium metal, remained the third most important chemical. Use of lithium fluoride and chloride as a flux in welding and brazing continued, as did use of lithium hypochlorite as a bleach and swimming pool disinfectant. Growth in the use of lithium organic catalysts, primarily butyllithium, was modest, primarily because butyllithium was geared to production of synthetic rubber for automotive use. Use of lithium metal in battery manufacture and organic-synthesis catalysis increased.

The domestic use of low-iron lithium mineral concentrates, as well as lithium carbonate, as substitutes for low-iron petalite ores previously imported from Rhodesia, in the production of low-expansion thermal-shock-resistant ceramics and other specialized ceramics continued to grow.

Demand for lithium compounds in dyes, paints, and resin catalysts increased significantly. Approximately 20% of lithium chemical sales were for products developed since 1970.

Prices.—The domestic price of ceramic-grade spodumene concentrate rose by approximately 40% to $123.50 per ton at yearend as reported in Ceramic Industry. Domestic prices of lithium carbonate and lithium hydroxide monohydrate, the two predominant chemicals, increased by approximately 40% to 79 cents and 87 cents per pound, respectively. The average price for exported lithium hydroxide monohydrate was 93 cents per pound. The domestic price of lithium metal, delivered in 1,000-pound lots, increased 15% to $9.38 per pound at yearend. An increase in demand for lithium carbonate by the aluminum industry was primarily responsible for the major price increases.

Foreign Trade.—United States exports of lithium chemicals are not completely reported in available trade data, with some of the compounds included inseparably with other non-lithium-bearing compounds. However, review of data on imports of lithium compounds from the United States by other countries indicated that in terms of lithium content, lithium carbonate accounted for nearly three-quarters of these exports in 1974, the remainder being largely lithium hydroxide. Japan, West Germany, and France received over 90% of apparent U.S. exports of lithium products. Apparent exports to Japan increased 17%. Trade data wth the United Kingdom were not available. Approximately 1,500 tons of spodumene concentrate, containing an estimated 40 tons of lithium, was shipped to West Germany, France, Belgium–Luxembourg, and the Netherlands, an increase of 23% over 1973.

Imports of lithium-mineral concentrate was one-half of the 1973 level at 3,165 tons and equaled less than 2% of total domestic lithium mine production capacity. Brazil supplied 75% of the imports primarily as hand-picked petalite for use in low-expansion ceramicware; the balance was spodumene concentrate from Canada.

Table 3.—U.S. imports for consumption of lithium mineral concentrate by country of origin and U.S. customs district

Country and customs district	1973		1974	
	Quantity (short tons)	Value (thousands)	Quantity (short tons)	Value (thousands)
Baltimore district:				
Brazil	5,308	$334	2,379	$217
South Africa, Republic of	565	47	--	--
Buffalo: Canada	--	--	786	106
Pembina: Canada	205	51	--	--
Total	6,073	432	3,165	323

Table 4.—Lithium metal and compounds: Apparent U.S. exports [1]
(Short tons)

Commodity	Belgium-Luxembourg	France	Germany, West	Italy	Japan	Netherlands	Spain	Total	Total lithium content
1973									
Gross weight:									
Lithium carbonate	12	54	1,411	10	1,067	NA	45	2,599	488
Lithium hydroxide [2]	26	396	297	51	308	22	94	1,194	196
Lithium chloride	NA	NA	12	NA	56	NA	([3])	68	11
Lithium bromide	NA	NA	NA	NA	553	NA	NA	553	44
Lithium metal	--	--	7	7	17	NA	--	31	31
Lithium content (total)	6	75	323	17	322	4	23	770	770
1974									
Gross weight:									
Lithium carbonate	--	172	1,475	NA	1,480	NA	65	3,192	599
Lithium hydroxide [4]	--	274	249	NA	412	NA	104	1,039	171
Lithium chloride	NA	NA	19	NA	([3])	NA	--	19	3
Lithium bromide	NA	NA	NA	NA	[5]163	NA	NA	[5]163	13
Lithium metal	--	--	6	--	18	NA	--	24	24
Lithium content (total)	NA	77	327	NA	377	NA	29	810	810

NA Not available.

[1] Only in the case of lithium hydroxide are U.S. exports of lithium chemicals reported separately in official U.S. trade statistics. Lithium metal exports are also reported in a basket category. Data in this table are derived from import statistics of major trading partner countries.

[2] Officially recorded U.S. exports totaled 522 short tons, distributed as follows: Australia—26, Canada—24, Chile—5, Colombia—13, France—184, West Germany—38, India—5, Indonesia—16, Italy—3, Japan—107, Mexico—43, Netherlands—5, New Zealand—7, Pakistan—3, Philippines—27, the Republic of South Africa—11, Spain—5, and the United Kingdom—less than ½ unit.

[3] Less than ½ unit.

[4] Officially recorded U.S. exports totaled 599 short tons, distributed as follows: Argentina—5, Belgium-Luxembourg—2, Bolivia—2, Brazil—2, Canada—23, France—124, West Germany—55, India—2, Indonesia—6, Italy—20, Japan—181, the Republic of Korea—1, Mexico—21, the Netherlands—56, Romania—5, Spain—36, Sweden—less than ½ unit, and the United Kingdom 58.

[5] Reported as lithium bromide plus potassium bromide; 50% of total assumed to be lithium bromide.

World Review.—*Brazil.*—Brazil's potential as an important source of glass- and ceramic-grade lithium ores was further explored by Companhia Estanifera do Brazil, and 29 outcrops have been discovered in the province of Minas Gerais. Small amounts of handpicked ore were produced for domestic consumption in manufacture of black-and-white television tubes. A few thousand tons of handpicked petalite ore was exported to Corning Glass Works in the United States, one-third less than in 1973. Brazil produced approximately 50 tons of lithium carbonate from the mineral amblygonite.

Canada.—Successful operation of a pilot plant by Tantalum Mining Co. (Tanco) at Bernic Lake, Manitoba, demonstrated a method for producing a low-iron (0.1% Fe_2O_3) spodumene concentrate suitable for the ceramics and specialty market. A lower grade lithium byproduct was found suitable as feedstock for a lithium carbonate plant. Plans were announced to build, by early in 1977, a facility with an annual capacity of 5,000 tons of lithium carbonate and 1,500 tons of low-iron spodumene concentrate. Kawecki Berylco Industries, Inc., of New York acquired a 24.9% interest in Tanco in May. The largest previously known Canadian mine, Canada's only significant past producer, located in the Val d'Or-Amos area of Quebec, remained closed pending further price increases on the world market. A small amount, 800 tons, of spodumene concentrate was exported to the United States, a fourfold increase over that of 1973.

Table 5.—Lithium minerals and chemicals: Estimated world supply
(Short tons lithium content)

Country group	1973	1974
Market economy countries	5,500	6,200
Centrally planned economy countries	1,500	1,800
Total	7,000	8,000

Table 6.—Lithium mineral concentrate: World production by country

(Short tons)

Country[1]	Mineral produced	1972	1973	1974[p]
Argentina	Not specified	54	110	[e] 110
Australia	do	[r] 1,181	244	[e] 220
Brazil[2]	do	--	5,308	2,379
Canada[2]	Spodumene	--	205	786
Mozambique[3]	Lepidolite	[r] 11	--	--
Portugal	do	1,323	1,102	992
Rhodesia, Southern[4]	Not specified	[r] 15,000	15,000	15,000
Rwanda	Amblygonite	--	25	[e] 30
South Africa, Republic of	Spodumene	--	--	458
South-West Africa, Territory of[5] [e]	do	4,130	5,914	6,092
United States	Not specified	W	W	W

[e] Estimate. [p] Preliminary. [r] Revised. W Withheld to avoid disclosing individual company confidential data.

[1] In addition to the countries listed, others (notably the U.S.S.R.) may produce lithium minerals, but available information is inadequate to make reliable estimates of output levels.

[2] U.S. imports from listed producing countries.

[3] Official import statistics of trading partner countries reported significantly higher imports of lithium-bearing minerals from Mozambique than were reportedly produced in that country. The excess is presumably of Southern Rhodesian origin.

[4] Output has not been reported since 1964, but presumably has continued at a reduced level. Lithium minerals reported produced in 1964 were petalite, lepidolite, spodumene, and eucryptite.

[5] Output has not been reported since 1966, but presumably has continued, inasmuch as a number of countries record imports from "South Africa" which in total considerably exceed reported output of the Republic of South Africa. Estimates given represent total reported imports from South Africa by the United States and the European Community less the reported output of the Republic of South Africa. These quantities, however, may include significant amounts originating in Southern Rhodesia (see footnotes 3 and 4) rather than in the Territory of South-West Africa. In 1966, total reported production was distributed as follows, in short tons: Amblygonite—30; lepidolite—365; petalite—1,344.

Table 7.—Reported world trade in lithium compounds[1]

(Short tons of contained lithium)

Importing countries	Source countries									
	United States		U.S.S.R.		Germany, West		Other		Total	
	1973	1974	1973	1974	1973	1974	1973	1974	1973	1974
Belgium-Luxembourg:										
Carbonate	2	--	13	3	6	2	7	18	28	23
Hydroxide	4	--	--	--	23	20	2	8	29	28
Chloride	NA	NA	NA	NA	[2] 1	[2] 1	NA	NA	[2] 1	[2] 1
Total	6	NA	13	3	30	23	9	26	58	52
France:										
Carbonate	10	32	40	17	22	20	--	5	72	74
Hydroxide	65	45	19	19	8	16	--	8	92	88
Chloride	NA	NA	NA	NA	[2] 17	[2] 14	NA	NA	[2] 17	[2] 14
Metal	--	--	--	--	2	6	--	2	2	8
Total	75	77	59	36	49	56	NA	15	183	184
Germany, West:										
Carbonate	265	277	179	67	XX	XX	57	28	501	372
Hydroxide	49	41	70	28	XX	XX	16	13	135	82
Chloride	2	3	4	--	XX	XX	(3)	1	6	4
Metal	7	6	11	12	XX	XX	--	--	18	18
Total	323	327	264	107	XX	XX	73	42	660	476
Italy:										
Carbonate	2	NA	--	NA	24	17	5	8	31	25
Hydroxide	8	NA	--	NA	30	21	5	14	43	35
Chloride	NA	NA	NA	NA	[2] 6	[2] 4	--	--	[2] 6	[2] 4
Metal	7	--	--	4	33	--	--	5	40	9
Total	17	NA	NA	4	93	42	10	27	120	73
Japan:										
Carbonate	201	278	240	274	--	2	1	5	442	559
Hydroxide	51	68	65	28	--	--	--	--	116	96
Chloride	9	(3)	--	--	--	--	--	--	9	(3)
Bromide	44	[4] 13	--	--	--	--	--	--	44	[4] 13
Metal	17	18	--	--	(3)	(3)	--	--	17	18
Total	322	377	305	302	(3)	2	1	5	628	686

See footnotes at end of table.

Table 7.—Reported world trade in lithium compounds [1]—Continued

(Short tons of contained lithium)

Importing countries	Source countries									
	United States		U.S.S.R.		Germany, West		Other		Total	
	1973	1974	1973	1974	1973	1974	1973	1974	1973	1974
Netherlands:										
Carbonate	NA	NA	NA	NA	[2]9	[2]3	(3 5)	NA	[2][5]9	[2]3
Hydroxide	4	NA	5	NA	4	NA	1	11	14	11
Chloride	NA	NA	NA	NA	[2]11	[2]11	NA	NA	[2]11	[2]11
Metal	NA	NA	NA	NA	[2]1	NA	NA	NA	[2]1	NA
Total	4	NA	5	NA	25	14	1	11	35	25
Spain:										
Carbonate	8	12	--	--	(3)	[6] 1	--	(3)	8	13
Hydroxide	15	17	--	(3)	7	9	(3)	1	22	27
Chloride	(3)	--	--	--	(3)	(3)	(3)	(3)	(3)	(3)
Metal	--	--	--	--	(3)	(3)	--	(3)	(3)	(3)
Total	23	29	--	(3)	7	10	(3)	1	30	40
Other countries:										
Carbonate	NA	NA	NA	NA	[6]57	[6]28	NA	NA	[6]57	[6]28
Hydroxide	NA	NA	NA	NA	[6]80	[6]42	NA	NA	[6]80	[6]42
Chloride	NA	NA	NA	NA	[6]4	[6]7	NA	NA	[6]4	[6]7
Metal	NA	NA	NA	NA	--	[6]14	NA	NA	--	[6]14
Total	NA	NA	NA	NA	[6]141	[6]91	NA	NA	141	91
Total [7]:										
Carbonate	488	599	472	361	[8]118	[8]73	70	64	1,148	1,097
Hydroxide	196	171	159	75	[8]152	[8]108	24	55	531	409
Chloride	11	3	4	--	[5]39	[8]37	(3)	1	54	41
Bromide	44	[4]13	--	--	--	--	--	--	44	[4]13
Metal	31	24	11	16	36	[8]20	--	7	78	67
Total	770	810	646	452	345	238	94	127	1,855	1,627

NA Not available. XX Not applicable.

[1] Compiled from import statistics of listed importing countries except where otherwise noted. Conversions to lithium content from reported gross weights were accomplished through the use of the following conversion factors: Lithium carbonate—multiply by 0.188; lithium hydroxide—multiply by 0.165; lithium chloride—multiply by 0.164; lithium bromide—multiply by 0.080. It should be noted that most of the reporting countries provide data for a basket category of "lithium oxide and hydroxide"; this has been assumed to be largely if not entirely the monohydrate of lithium hydroxide ($LiOH.H_2O$) and the factor used for converting gross weight of material so reported to lithium content is based on this assumption.

[2] Source: West German official export statistics because imports of this commodity by this country are not reported separately.

[3] Less than ½ unit.

[4] Source publication reports import of lithium bromide and potassium bromide as a single figure; entry here is an estimate based on the assumption that half of the total was lithium bromide.

[5] Source: France official export statistics because imports of this commodity for this country are not reported separately.

[6] Derived by subtracting reported receipts by listed importing countries from total recorded West German exports.

[7] Totals of listed figures except where otherwise indicated.

[8] Recorded total West German exports.

Table 8.—Lithium mineral concentrate: Imports of selected countries by country of origin [1]

(Short tons, gross weight)

Source country	Belgium-Luxembourg	France	Germany, West	Italy	Netherlands	United States	Total
1973							
Producing countries:							
Brazil	--	--	--	--	[2] 1,102	5,303	6,405
Canada	--	--	--	--	--	205	205
Mozambique	7,789	1,200	--	--	[2] 8,650	--	17,639
South African Customs Union	--	931	4,418	--	[2] 1,371	565	7,285
United States	22	66	179	--	[2] 179	XX	446
Nonproducing countries:							
Belgium-Luxembourg	XX	87	--	--	NA	--	87
Germany, West	28	3	XX	300	NA	--	331
Netherlands	339	396	1,166	795	XX	--	2,696
Unspecified countries	--	--	11	88	NA	--	99
Total	8,178	2,683	5,774	1,183	11,302	6,073	35,193
1974							
Producing countries:							
Brazil	--	--	--	NA	--	2,379	2,379
Canada	--	--	--	NA	--	786	786
Mozambique	7,971	1,069	194	NA	[2] 4,363	--	13,597
South African Customs Union	--	2,885	3,661	NA	[2] 258	--	6,804
United States	--	500	559	NA	[2] 309	XX	1,368
Nonproducing countries:							
Belgium-Luxembourg	XX	--	--	NA	NA	--	NA
Germany, West	([3])	--	XX	NA	NA	--	([3])
Netherlands	324	686	217	NA	XX	--	1,227
Unspecified countries	--	132	46	417	NA	--	595
Total	8,295	5,272	4,677	417	4,930	3,165	26,756

NA Not available. XX Not applicable.

[1] Compiled from import statistics of listed recipient countries.

[2] Data may include minor quantities of material other than lithium minerals.

[3] Included with imports from the Netherlands.

France.—France imported a total of 184 short tons of lithium equivalent as chemicals and metal, primarily from the United States, West Germany, and the U.S.S.R., in order of volume; the total was virtually unchanged from that of 1973. Approximately 5,000 tons of lithium-mineral concentrate, twice as much as in 1973, was imported, primarily from the Republic of South Africa and Mozambique, but including 500 tons from the United States. Rhône-Poulenc produced lithium compounds, mainly hydroxide, for grease manufacturing. Lithium chemical exports, mainly hydroxide, totaled 20 tons of lithium equivalent, mainly to West Germany.

Germany, West.—As Europe's largest producer of secondary lithium salts, West Germany imported a total of 476 short tons of lithium equivalent, mainly as lithium carbonate and lithium hydroxide, primarily from the United States and the U.S.S.R. Imports were 28% less than 1973. The main reduction was in receipts from the U.S.S.R. Approximately 5,000 tons of lithium mineral concentrate was imported in 1974, about 20% less than in 1973; the principal supplier was South Africa, but 600 tons of spodumene concentrate was imported from the United States. Metallgesellschaft AG at Langelsheim produced lithium hydroxide, butyllithium, lithium halide and lithium metal, using lithium carbonate as the major feedstock. A total of 238 tons of lithium equivalent was exported in lithium chemicals, a 31% reduction from 1973. Twenty short tons of lithium metal was exported, primarily to Switzerland.

Japan.—A total of 686 tons of lithium equivalent as chemicals and metal was imported primarily from the United States and the U.S.S.R.; this represented a 9% increase over 1973. A primary use of these chemicals was in the manufacture of lithium bromide for adsorption air conditioning, demand for which was about 3,000 tons in 1974 and a 50% rise in demand was estimated for 1975. Honjo Chemical Co., the largest Japanese manufacturer of lithium bromide and other lithium chemicals, used 1,100 tons of lithium carbonate to manufacture lithium bromide in 1973. Japan Lithium Co. announced plans to build a 1,500-ton lithium bromide plant by August 1975. Use of lithium carbonate in aluminum cells has not been extensive, only a few hundred tons per year. Lithium chemicals were also used in the manufacture of ceramics, greases, and fluxes.

Mozambique.—Approximately 14,000 short tons of lithium mineral concentrate was shipped to Western Europe, primarily Belgium-Luxembourg and the Netherlands, representing a 23% reduction from that of 1973.

South Africa, Republic of, and Territory of South-West Africa.—The annual capacity of southern Africa's only two large operating mines, Helicon and Rubicon, located southeast of Karibib, and owned by S.W.A. Lithium Mines (Pty.) Ltd., a West German-controlled firm, was estimated to be 11,000 short tons of lepidolite concentrate and 2,800 short tons of petalite concentrate. The working life of these mines was determined to be 20 years. Production figures were not available. Exports of high-grade petalite to Europe remained high. A total of approximately 7,000 short tons of mineral concentrate was exported to Western Europe, primarily to West Germany and France, representing a 7% decrease below that of 1973.

Central Economy Countries.—The U.S.S.R. produced lithium carbonate and hydroxide from spodumene ore. Production figures were not available. The U.S.S.R. was the only major producer of lithium chemicals and metal from ore other than the United States. Exports, measured by trading partner receipts, primarily lithium carbonate with the balance mainly lithium hydroxide, had risen steadily from 260 tons lithium content in 1968 to 646 tons in 1973 but dropped to 452 tons in 1974. All exported lithium hydroxide was reported to be void of Li_6 isotope. An upturn in lithium bromide demand was reported for domestic air conditioning.

The People's Republic of China was reported by the Canadian Mineral Resources Branch in 1973 to have produced 300 tons lithium equivalent of lithium products in 1972.

Other Countries.—Manufacture and use of lithium chemicals continued on a small scale in Italy, Belgium-Luxembourg, and the Netherlands, in order of importance, using imported lithium carbonate and hydroxide and some lithium mineral concentrate as feedstock. Italy imported 73 short tons of lithium equivalent as chemicals and metal, 39% less than in 1973, primarily from West Germany. Italy exported approximately 10,000 tons of lithium mineral concentrate to Israel in 1974. Belgium-Luxembourg imported 52 tons of lithium equivalent as chemicals, about the same as in 1973, and 8,000 tons of lithium mineral concentrate, primarily from Mozambique, about the same as in 1973. The Netherlands imported 25 tons of lithium equivalent as chemicals primarily from West Germany. In addition, approximately 5,000 tons of lithium mineral concentrate was imported mainly from Mozambique, a 56% decrease from 1973. Approximately 1,200 tons of lithium minerals was exported by the Netherlands, primarily to France, Belgium-Luxembourg and West Germany. Production and trade data on the United Kingdom were not available, but over 200 tons total of lithium equivalent as chemicals was reportedly imported in 1973.

World Reserves.—World reserves were estimated to contain 744,000 short tons of lithium; of this, 327,000 tons are located in the United States, 200,000 tons in the U.S.S.R., 100,000 tons each in Africa and Canada, and 17,000 tons in other countries. World reserves were in pegmatite dikes containing 0.5% to 2% lithium and in surface and underground brines. World resources were estimated to contain in excess of 10 million tons of lithium. Although the United States has nearly one-half of the world's known reserves, it probably has less than 20% of the world's identified resources.

Technology.—Development work on rechargeable lithium batteries for electric vehicle surface propulsion and for electrical energy storage in stationary systems for peak-load use continued but at a less accelerated rate. High corrosivity of molten lithium metal at high cell operating temperatures, typically 600° C, was a major problem. Development of lithium alloys, such as lithium-aluminum, partially alleviated this problem in 1974, and a rechargeable lithium-sulfur cell was operated for 1,000 hours at Argonne National Laboratories[5] without damage to a boron-nitride fabric separator. An engineering analysis by Lawrence Livermore Laboratory[6] of Lockheed's lithium-water-air battery recommended further studies to lower the regeneration cost of lithium metal.

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[5] Chemical & Engineering News. Coal, Biochemistry in Argonnes Wider Focus. V. 52, No. 31, Aug. 5, 1974, pp. 18–21.

MEERSCHAUM[7]

Crude meerschaum was not imported by the United States for the second consecutive year. However, imports of crude meerschaum were expected to be received from Turkey and Somalia in early 1975. Turkey and Somalia have been the principal sources for the past 5 years.

QUARTZ CRYSTAL[8]

ELECTRONIC-GRADE

Production of cultured quartz crystal in 1974 reached record levels by posting a 72% increase over that of 1973 to 528,664 pounds. Cultured quartz consumption exceeded that of natural quartz for the fourth consecutive year. Consumption of both forms of quartz crystal increased. Imports of natural quartz crystal and exports of cultured quartz crystal also were up. Exports of natural quartz were down 81% in quantity in 1974. Production of finished piezoelectric units increased significantly to 35,541,110 units.

Legislation and Government Programs.—The stockpile objective for electronic-grade quartz crystal remained at 209,000 pounds. Continued sales of excess quartz crystal by the General Services Administration led to a decline in the Defense Materials Inventory from 4.05 million pounds of stockpile-grade material at the end of 1973 to 3.82 million pounds at the end of 1974. The non-stockpile-grade quartz inventory declined from 175,096 pounds in 1973 to 4,121 pounds at the end of 1974.

Domestic Production.—There was no reported domestic production of natural electronic-grade quartz crystal during 1974. Seven companies reported production of cultured quartz for use by the quartz crystal cutting industry. These companies were P. R. Hoffman, Carlisle, Pa.; Motorola, Inc., Chicago, Ill.; Bliley Electric Co., Cortland, Ohio; Sawyer Research Products, Inc., Eastlake, Ohio; Thermodynamics Corp., Shawnee Mission, Kans.; Western Electric Co., Inc., North Andover, Mass.; and Electro Dynamics Corp., Shawnee Mission, Kans. Electro Dynamics became the seventh firm to commercially produce cultured quartz and the first to start production since 1970.

Cultured quartz production increased 72% from the revised reported production in 1973 of 306,578 pounds to 528,664 pounds in 1974. The increased production was the result of capacity expansion programs at Thermodynamics and Sawyer Research. Thermodynamics' program led to a more than doubling of capacity for growth of cultured quartz. Additionally, Thermodynamics added a complete facility to process its own cultured quartz. Sawyer Research completed installation of additional crystal growing units, which resulted in an increase of its productive capacity by about one-third.

Consumption and Uses.—Consumption of raw (uncut natural or cultured) quartz crystal climbed to 284,982 pounds, the highest total since 1967. Consumption of natural quartz crystal increased 23% from 99,395 pounds in 1973 to 121,856 pounds in 1974. Cultured quartz consumption exceeded that of natural quartz for the fourth consecutive year. Consumption of cultured quartz increased 9% from 149,534 pounds in 1973 to 163,126 in 1974. The number of finished crystal units fabricated from both forms of raw quartz increased 32% to 35,541,110 units in 1974.

The 1973 production/consumption data were derived from reports received from 35 crystal cutting operations in 14 States. Finished piezoelectric units were produced by 27 of the cutters; the remainder produced only semifinished blanks. Of these, 2 companies consumed natural quartz only, 20 cut cultured quartz only, and 13 cut both natural and cultured quartz.

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[6] O'Connell, L. G., B. Rubin, E. Behrin, I. Y. Borg, J. F. Cooper, and H. J. Weisner. The Lithium-Water-Air Battery: A New Concept for Automotive Propulsion. Lawrence Livermore Laboratory, UCRL-51811, May 1, 1975, 36 pp.

[7] Prepared by A. C. Meisinger, industry economist.

[8] Prepared by Stanley Haines, physical scientist.

Seventeen consumers in four States accounted for 85% of the raw quartz crystal consumed in 1974. Pennsylvania was the leading quartz crystal consuming State with over 38% of the total followed by Kansas, Illinois, and Massachusetts.

Piezoelectric units were manufactured by 44 producers in 18 States. Seventeen of these producers worked from partially processed quartz crystal blanks and consumed no raw quartz. Seventeen plants in five States, Kansas, Florida, Pennsylvania, Illinois, and Massachusetts, supplied over three-fourths of the total output of finished crystal units. Oscillator plates comprised 75% of production. The remainder was used for filter plates, telephone resonator plates, and other items.

McCoy Electronics Co. announced that it had purchased the crystal processing equipment from the Collins Radio Co. plant in Newport Beach, Calif. The equipment is being used in the Mt. Holly Springs, Pa., plant and also in the new plant in Mercersburg, Pa.

Stocks.—Total stocks of raw quartz crystal (cultured and natural) increased 124% from 114,205 pounds in 1973 to 256,373 in 1974. Of this total, 174,998 pounds was natural quartz, and 81,375 pounds was cultured quartz.

Foreign Trade.—United States exports of natural quartz crystal decreased 19% from 205,420 pounds in 1973 to 165,837 pounds in 1974. Exports of cultured quartz increased 62% from 82,241 pounds in 1973 to 133,035 pounds in 1974. The average price of natural quartz exported was $9.84 per pound; that of cultured quartz was $20.78 per pound.

Imports of raw natural quartz crystal, valued at more than $0.50 per pound, increased 274% in quantity to 388,677 pounds and 300% in value to $367,943 in 1974. Quartz imported in the over $0.50 per pound category has in the past been reported as electronic and optical-grade quartz crystal. However, as a result of price increases for Brazilian lasca, the nonelectronic-grade quartz used to grow cultured quartz, almost all quartz imported into the United States after September 26, 1974, was valued at over $0.50 per pound. This effectively eliminated the dividing line in trade data between electronic and optical-grade quartz crystal, and lasca. The 389,000 pounds listed in the table as imports of natural quartz crystal is partially electronic-grade quartz and partially the lower quality lasca. Brazil supplied 89% of the quartz crystal in this category. The remainder was supplied by West Germany, the United Kingdom, Israel, Canada, and Venezuela.

Imports of quartz valued at under $0.50 per pound totaled 1,343,236 pounds, valued at $256,405. This quartz was used to manufacture fused quartz and as a nutrient material in the production of cultured quartz. Brazil provided all of the material imported in this category.

World Review.—*Brazil.*—On September 15, 1974, Brazil suspended exports of all quartz materials due to what was believed to be unrealistic pricing and classification procedures in Brazil. The suspension was lifted on September 26, 1974, with the announcement of an export limit of 662 short tons for lasca through December 1974. A floor price of $3.50 per kilogram was set for the lasca. Brazil announced an export quota for 1975 of 3,859 short tons of lasca. The floor prices announced for 1975 were to be $6 per kilogram of first-grade lasca; $3.50 per kilogram of second-grade lasca; and $1.60 per kilogram of third-grade lasca.

In 1974, lasca exports totaled 7,619 tons valued at $6.1 million. Piezoelectric-grade exports totaled 38 tons valued at $116,000.

Technology.—An experiment was performed by astronauts on Skylab 3 and 4 to see what effects zero gravity would have on the growth of crystals. The two major results of the experiments, which grew crystals of germanium and selenium, were higher quality crystals than earth-grown varieties and a faster growth rate. If such experiments could be expanded to include quartz, a new generation of higher quality quartz crystal could evolve.[9]

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[9] Chemical Engineering. Zero Gravity of Space Aids Crystal Growth. V. 52, No. 41, Oct. 14, 1975, p. 8.

Table 9.—Salient electronic- and optical-grade quartz crystal statistics
(Thousand pounds and thousand dollars unless otherwise noted)

	1972	1973	1974
Production of cultured quartz	160	r 307	529
Imports of electronic- and optical-grade natural quartz crystal:			
Quantity	65	104	389
Value	78	92	368
Exports of electronic- and optical-grade quartz crystal:			
Quantity	149	287	299
Value	1,228	3,283	4,398
Natural:			
Quantity	90	205	166
Value	587	1,933	1,634
Cultured:			
Quantity	59	82	133
Value	641	1,350	2,764
Consumption of raw electronic-grade quartz crystal	189	249	285
Natural	87	99	122
Cultured	102	150	163
Production piezoelectric units, number thousands	25,555	27,006	35,541

r Revised.

STAUROLITE [10]

Staurolite is a complex iron-aluminum silicate of uncertain and most likely variable composition. The mineral occurs as opaque crystals that are reddish-brown to black, have a specific gravity of 3.65 to 3.77, and fall between quartz and topaz in hardness (7 to 8 on Moh's scale). Aside from a small rock-shop trade in cruciform-twinned crystals from some deposits that are sold as curiosities or amulets ("fairy crosses"), all the staurolite produced commercially in the United States is a byproduct obtained by high-intensity magnetic separation of a heavy-mineral mixture recovered by E. I. du Pont de Nemours & Co., Inc., from beach sand in a glacial age deposit in Clay County, Fla.

Formerly the staurolite concentrate was used only as an ingredient in portland cement mixtures, but more recently this product (which may contain minor proportions of five or six other minerals and averages approximately 45% Al_2O_3, 15% Fe_2O_3, and 30% SiO_2) is being marketed by du Pont under two trade names, "Starblast" for use as a sandblast abrasive, and "Biasil" for mixing with bentonite and other substances to prepare special-purpose foundry sand.

Quantitative production data are not released for publication, but the 1974 output of staurolite was 12% greater than that of 1973 while shipments increased 11% in tonnage and 28% in total value.

STRONTIUM [11]

Domestic consumption of strontium on a strontium carbonate basis was estimated at 25,000 tons in 1974, representing a 24% decrease from that of the previous year. Imports of strontium minerals increased sharply over 1973 to 38,431 tons. Imports of strontium chemicals, primarily from Canada, also increased 47% compared with those in 1973.

Legislation and Government Programs.—The Government sold 4,052 tons of stockpile-grade celestite during 1974. Government stockpiles contained 14,408 tons of non-stockpile grade at yearend.[12]

Domestic Production.—Strontium minerals have not been produced commercially in the United States since 1959. However, a number of firms produced strontium compounds from imported celestite, a strontium sulfate.

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[10] Prepared by J. Robert Wells, physical scientist.

[11] Prepared by W. Timothy Adams, physical scientist.

[12] General Services Administration. Stockpile Report to the Congress, July-December 1974. 29 pp.

Table 10.—Major producers of strontium compounds, 1974

Company	Location	Compounds
Atomergic Chemetals Co	Carle Place, N.Y	Various compounds.
J. T. Baker Chemical Co	Phillipsburg, N.J	Do.
Barium & Chemicals, Inc	Steubenville, Ohio	Do.
Chemical Products Corp	Cartersville, Ga	Carbonate.
E. I. du Pont de Nemours & Co., Inc	Grasselli, N.J	Nitrate.
FMC Corp	Modesto, Calif	Carbonate, hydrate, nitrate.
Hercules Inc	Glens Falls, N.Y	Chromate.
King Laboratories, Inc	Syracuse, N.Y	Metal alloys.
Mallinckrodt Chemical Works	St. Louis, Mo	Various compounds.
Mineral Pigments Corp	Beltsville, Md	Chromate, molybdate.
NL Industries, Inc., Tam Div	South Amboy, N.J	Titanates.

Prices.—At yearend, prices quoted in the Chemical Marketing Reporter were as follows: Strontium carbonate—technical, bags, carlots, works, 13 to 21 cents per pound; strontium nitrate—bags, carlots, works, $15 per 100 pounds, unchanged from the previous year. Prices for strontium minerals are usually determined by direct negotiation between buyer and seller and are seldom published. The average value of imported strontium minerals at foreign ports was $30 per short ton.

Foreign Trade.—Imports of strontium minerals totaled 38,431 tons, a 42% increase over those of 1973. The material was imported from Mexico and Spain. Imports of strontium compounds increased 47% over those of 1973 with 94% of the material coming from Canada. Quantitative data on U.S. exports of strontium compounds were not available.

Consumption and Uses.—Domestic consumption of celesite in the manufacture of various strontium chemicals continued its decline from the 1971 high as carbonate from Canada entered the market in larger quantities. Quantitative information concerning consumption is incomplete; however, one leading company reported a decrease in consumption in 1974 from that of 1973. Sales of domestically produced strontium carbonate to manufacturers of glass for color television picture tubes again declined. Celestite consumption in the manufacture of chemicals for pyrotechnics appeared to have been stabilized.

Miscellaneous applications for strontium compounds included ferrites, greases, ceramics, plastics, toothpaste, pharmaceuticals, paint, electronic components, welding fluxes, and high-purity zinc. Small quantities of strontium metal were used by research companies.

Table 11.—U.S. imports for consumption of strontium minerals,[1] by country

Country	1973		1974	
	Quantity (short tons)	Value (thousands)	Quantity (short tons)	Value (thousands)
Guatemala	78	$2	--	--
Mexico	22,553	555	30,935	$875
Spain	4,409	100	7,496	270
Total	27,040	657	38,431	1,145

[1] Strontianite or mineral strontium carbonate and celestite or mineral strontium sulfate.

Table 12.—U.S. imports for consumption of strontium compounds, by country

Country	1973		1974	
	Pounds	Value	Pounds	Value
Strontium carbonate, not precipitated:				
Austria	1,666	$1,155	--	--
Canada	848,000	90,188	2,910,005	$274,485
Germany, West	5,512	2,651	--	--
Switzerland	--	--	2,205	647
Total	855,178	93,994	2,912,210	275,132
Strontium carbonate, precipitated:				
Belgium-Luxembourg	79,366	19,420	--	--
Canada	9,392,385	1,026,838	12,346,082	1,867,147
Germany, West	--	--	39,242	9,944
Italy	342,431	82,101	634,928	163,204
Netherlands	--	--	4	421
Switzerland	--	--	79,366	22,157
United Kingdom	--	--	39,682	7,836
Total	9,814,182	1,128,359	13,139,304	2,070,709
Strontium chromate:				
Belgium-Luxembourg	--	--	22,000	19,300
Canada	r 636,000	r 421,000	618,450	503,357
France	--	--	78,483	43,075
Germany, West	--	--	74,333	78,584
United Kingdom	--	--	20,000	17,262
Total	r 636,000	r 421,900	813,266	661,578
Strontium nitrate:				
Canada	76,596	10,437	109,333	20,480
Germany, West	1,761	729	1,100	379
Total	78,357	11,166	110,433	20,859
Strontium compounds, n.s.p.f.:				
France	2,205	4,258	2,865	6,956
Germany, West	255,735	57,140	116,109	59,660
Japan	1	1,770	--	--
United Kingdom	2,070	5,040	2	314
Total	260,011	68,208	118,976	66,930
Grand total	r 11,643,728	r 1,723,627	17,094,189	3,095,208

r Revised.

Table 13.—Strontium minerals: World production by country

(Short tons)

Country [1]	1972	1973	1974 p
Algeria	2,084	e 2,100	e 2,100
Argentina	1,208	817	580
Canada e	65,000	65,000	60,000
Iran e [2]	330	330	330
Italy	810	810	827
Mexico	26,923	20,143	32,568
Pakistan	378	3	400
Spain	8,818	8,818	e 8,800
United Kingdom	4,850	4,782	2,205
Total	110,401	102,803	107,810

e Estimate. p Preliminary.

[1] In addition to the countries listed, West Germany, Poland, and the U.S.S.R. produce strontium minerals, but output is not reported quantitatively and available information is inadequate to make reliable estimates of output levels.

[2] Year beginning March 21 of that stated.

World Review.—*Canada.*—Kaiser Strontium Products Ltd. marketed strontium chemicals worldwide from its plant at Point Edward, Cape Breton Island, Nova Scotia. Technical problems that hampered the commercial-scale production of glass-grade strontium carbonate appeared to be under control.

Technology.—An Al-16% Si-10% strontium master alloy for modifying hypoeutectic aluminum-silicon alloys, which offers substantial cost advantages over the conventional sodium method, was marketed. Addition of the strontium master alloy was convenient and recovery of the strontium was satisfactory. Fume generation and uncertain recovery, major problems associated with sodium modification, were eliminated. Additions of the new master alloy resulted in 20% to 100% increases in elongation and significant increases in tensile and yield strengths of cast and machined test bars.[13]

WOLLASTONITE[14]

Wollastonite is a natural calcium metasilicate, usually white or light-colored and sometimes acicular to silky fibrous in structure, with a specific gravity of 2.87 to 3.09 and a Moh's hardness of 4½ to 5. The mineral, useful as a ceramic raw material, as a filler for plastics and asphalt products, as a pigment and extender for paints, and in miscellaneous minor applications, was mined in the United States in 1974 by Interpace Corp. at an underground operation in Essex County, N.Y. Specific output data were not released for publication, but the tonnage produced in 1974 was 2% less than that in 1973, while the reported total value was higher. Of interest in this regard was a communication published in an industrial magazine[15] implying that current domestic production of wollastonite is in the neighborhood of 50,000 tons per year. The same letter stated that wollastonite can serve in certain applications as a satisfactory substitute for asbestos, obviating exposure of the involved workers to the health hazards of that material.

Chemical Marketing Reporter, December 30, 1974, quoted $43.80 per ton as the price for wollastonite, fine paint grade, bagged, in carload lots, f.o.b. works. The price range quoted in the December 1974 issue of Industrial Minerals (London) for wollastonite (imported ground, bagged, CIF main European port) was approximately equivalent to from $76 to $94 per ton.

Production of wollastonite outside the United States in 1974 was reported at Lappeenranta, Finland (flotation concentrate said to amount to about 7,000 tons), and from a newly discovered deposit near Sirohi, Rājasthān, India (quantity not specified).[16]

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[13] Modern Casting. V. 65, No 7, July 1975, p. 42.

[14] Prepared by J. Robert Wells, physical scientist.

[15] Choate, L. W. Setting the Record Straight. Eng. and Min. J., v. 176, No. 1, January 1975, p. 4.

[16] Industrial Minerals (London). No. 81, June 1974, pp. 38, 71.

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